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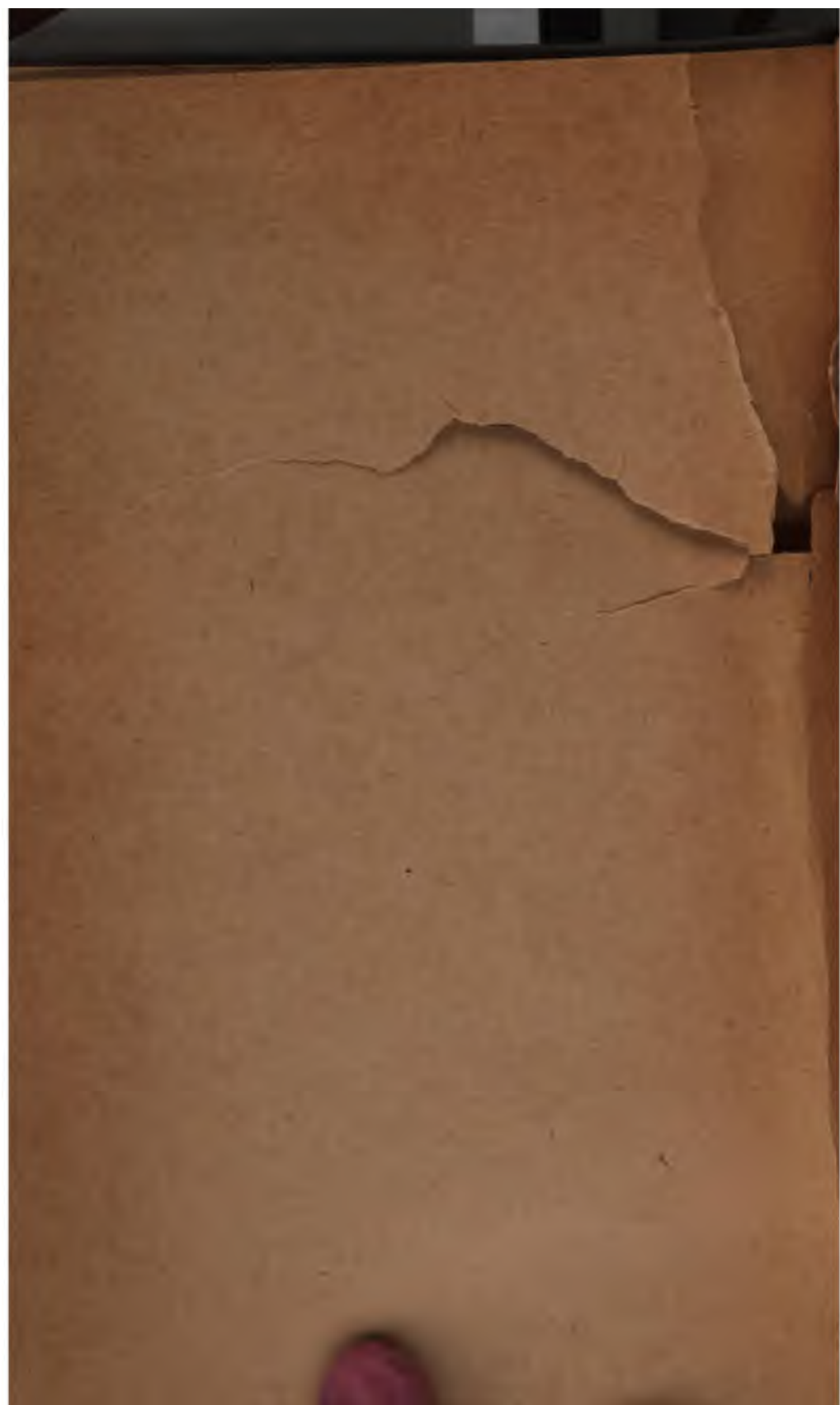
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ERRATA

Page 211, top line, for Bibliography read Bibliography.

“ 367, line 16 from bottom, for *S. salinarum* read *O. salinarum*.

“ 445, line 2 from top, for *F. annonæ* read *E. annonæ*.

“ 468, line 6 from top, for ziphisternal read xiphisternal.

“ 470, first 5 lines should follow description No. 11, p. 469.

“ 477, footnote, for Siences read Sciences, closly read closely, and herpelology read herpetology,

“ 565, last column of table, for *Palæsypos* read *Palæsyops*.

“ 593, line 6 from bottom, for typically read atypically.

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**Article I.—THE SCHRAMMEN COLLECTION OF CRETACEOUS
SILICISPONGIÆ IN THE AMERICAN MUSEUM OF
NATURAL HISTORY**

WITH NOTES ON THE STRUCTURE, CLASSIFICATION, GEOLOGICAL AND
GEOGRAPHICAL DISTRIBUTION, AND SYNONYMY OF THE
SILICISPONGIÆ

BY MARJORIE O'CONNELL, PH.D.

PLATES I TO XIV

PREFACE

The following paper was written primarily as a series of notes on the kinds of types in the Schrammen Collection of Silicispongiæ in The American Museum of Natural History, these notes now forming Chapter IV. It seemed advisable for many reasons to include an account of the historic development of the science of palæospongiology, and a description of the morphological characteristics of the Silicispongiæ, which constitute Chapters I and II. Since Schrammen's material came from many localities in Germany, and from successive horizons in the Upper Cretaceous, it appeared to me that a general summary of the stratigraphy of the Cretaceous sponge-bearing horizons of Europe would be of service to the student especially since stratigraphic texts contain little information about sponge localities, while writers on sponges have not given much heed to broad stratigraphic correlations. This summary is given in Chapter III.

I was able to write the first three chapters in time made available to me under the Sarah Berliner Research Fellowship for Women, which I held for the year 1917-1918. These chapters constitute the preliminary work on my research problem which deals with the habitat of the Silicispongiæ.

The arrangement of the Schrammen Collection was undertaken at the suggestion of Associate Curator Chester A. Reeds, who, throughout the work, placed every facility at my disposal for its speedy completion and himself gave much time to the preparation of the plates and the reading of the manuscript. To Curator E. O. Hovey my thanks are due for careful attention to the manuscript, after his return from the Arctic, and for numerous helpful suggestions.

American Museum of Natural History,
November, 1918.

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INTRODUCTION

The Schrammen collection of sponges comprises 222 species,¹ distributed in 116 genera, and numbers 800 specimens. It was acquired by The American Museum of Natural History by purchase in 1914 from Doctor Anton Schrammen of the Roemer Museum at Hildesheim, Hanover, Germany. The material is a part of that used by Schrammen in his Monograph on the Silicispongiæ of Northwest Germany, few of the specimens being the actual primary or proterotypes but nearly all of them coming from the type localities and forming a portion of the original series upon which the new species erected by that author are based. The specimens thus constitute tangible illustrations for the Monograph and many of them are superior to the illustrated forms. In this collection, the student may find an almost complete zoological representation of this interesting and all too little-known group of fossils.

All of the specimens belong to that group of sponges generally classed by palæontologists as Silicispongiæ. This term, in its earliest form, Silicea, dates back more than fifty years in the history of classification of the sponges, having been given by Bowerbank in 1864 to distinguish the forms with siliceous skeletal elements from those having calcareous elements. The designation, however, is unsatisfactory, as all later workers on the sponges have realized, for many of the Calcispongiæ have their skeletal elements or spicules secondarily silicified, while the spicules in the Silicispongiæ are calcified at times (Hinde, 1886). Since the students of fossil sponges have long recognized that the mineral condition in which the sponges are found is no clue to their genetic relationships, and since the real basis of classification has been the form of skeletal element, it would seem advisable to drop terms which were introduced at a time when the true structure of sponges was almost unknown and to adopt in nomenclature what has virtually been adopted in practice, namely, a morphological not a chemical basis for classification. Zoologists, working upon recent sponges, have taken the lead in this more scientific mode of designation, but palæontologists, following the classification erected by Zittel, still continue to divide fossil sponges into Calcispongiæ and Silicispongiæ, according to the calcareous or siliceous nature of the spicules, though the right is always

¹This number includes one variety and three mutations. The total of 800 does not include 300 specimens purchased in 1903 most of which are not types or cannot be determined because of insufficient labeling by Schrammen.

reserved of excluding calcareous sponges from the first class and siliceous ones from the second class if the form of skeletal element indicates a structural relation which does not agree with the mineralogical preservation. Thus, Zittel concludes his general statements on classification with the following remark: ". . . the distinction between siliceous and calcareous sponges in the fossil state depends entirely upon morphological characters, and not at all upon the chemical composition of the preserved parts" (Zittel, 1910, p. 47; 1913, p. 50). This is Zittel's last opinion, and yet he proceeded to divide the sponges into Calcispongiæ and Silicispongiæ and, since he was undoubtedly the greatest specialist on fossil sponges, no palæontologist has thought of departing from the classification which he not so much founded as perpetuated by setting upon it the seal of his approval. The classification based upon the composition of the skeletal elements and the one widely used in the current literature on fossil sponges is as follows:

Myxospongiæ.—These are recent forms entirely lacking any kind of skeleton.

Ceratospongiæ.—These are horny sponges possessed of a skeleton consisting of a network of anastomosing fibres of spongin, the fibres being either solid or containing an axial canal which is at times filled with particles of foreign matter such as sand grains or minute shell fragments. There are no undoubted fossil representatives of the Myxospongiæ or Ceratospongiæ, although it has been claimed that horny sponges have been found in the Mesozoic. This claim is open to question and probably all such horny sponges will be found to have been improperly identified. All fossil sponges are thus seen to fall into one or the other of the two remaining subclasses the Calcispongiæ or the Silicispongiæ.

The *Calcispongiæ* secrete a skeleton of calcareous spicules which are rod-like or else star-shaped with three or four rays, the three-rayed spicules being the most common. The calcareous sponges, at no time very abundant, are best represented in the Mesozoic, but become practically extinct in the Tertiary, though occasional characteristic spicules are found in the rocks, showing that they still inhabited the littoral zone of the sea. They have also been reported sparingly in the Palæozoic, but such occurrences are to be doubted. There are a few living forms such as species of *Leucosolenia*, *Grantia*, and others.¹

¹Specimens of recent forms are exhibited in the Darwin Hall of Invertebrates in The American Museum of Natural History.

The *Silicispongiae* are the most complicated and highly organized of the sponges and show the widest geological and geographical range. The skeleton is composed of siliceous elements alone or of siliceous spicules embedded in horny fibres. (See Chapter II for details.)

This classification is unsatisfactory not so much because of any failure on Zittel's part to recognize essential morphological characteristics—for he has the honor of being the first to classify fossil sponges on the basis of the form of the spicules—as because of the poor terminology for the larger subdivisions. Zittel, throughout his work on sponges, emphasized the value of the spicules in taxonomy and pointed out that while they show great variability in form, nevertheless, they are constant in each species and, being embedded in the soft parts, are least likely to be affected by any of the factors of environment, for which reasons he made the type of element the basis of classification not only for the smaller taxonomic divisions but for all higher divisions up through the orders. On account of the variability in external form and in the size of the sponges, it is at once apparent that such characteristics cannot be used in classification. Neither can the present chemical composition of the elements be considered diagnostic, for the siliceous spicules may become calcified, and even more frequently are the calcareous spicules silicified. One is thus reduced, for the fossil sponges at least, to the erection of a classification based almost wholly upon the form of the skeletal elements, although to a minor extent, where perfection of preservation permits, the character of the canal system and other structural features may be used.

A few comparatively slight changes in nomenclature used by von Zittel for the larger taxonomic divisions will suffice to emphasize in the classification the fundamental importance of the spicules which was first pointed out by that author and employed in all of his systemic work. It is interesting to note that the revised classification approaches closely the one first proposed by Zittel in 1878 in his 'Stammes-Geschichte der Spongien' and later amplified by him in his 'Handbuch der Palaeontologie.' At that time he had not adopted the term *Silicispongiae*, but simply recognized seven orders of equal value as follows:

MYXOSPONGIÆ Haeckel
CERAOSPONGIÆ Bronn
MONACTINELLIDÆ Zittel
TETRACTINELLIDÆ Marshall
LITHISTIDÆ Schmidt
HEXACTINELLIDÆ Schmidt
CALCISPONGIÆ Blainville

The following is the most recent expression of workers in this field, as it appears in the 1915 edition of Zittel's text-book edited by Broili, and there is given also the Zittel classification for comparison.

Zittel Classification, 1913 (Eastman translation)		Zittel Classification, 1915 (Broili revision)	
	Subclass	Subclass	Order
Phylum Porifera	MYXOSPONGIÆ		Myxospongia
	CERATOSPONGIÆ		Ceraospongia
	SILICISPONGIÆ	SILICISPONGIÆ	Tetractinellida
			Lithistida
			Monactinellida
			Triaxonia
	Hexactinellida		Hexactinellida
	CALCISPONGIÆ	CALCISPONGIÆ	Pharetrones
			Sycones

Zittel recognized that the Lithistida were very closely related to the Tetractinellida and, while he made a separate order of them, he frankly stated that many zoologists included them with the Tetractinellida. Schrammen's detailed studies over a period of twenty years have convinced him so thoroughly of the impropriety of separating the Lithistida as a distinct order that in his Monograph he drops that class name altogether.

CHAPTER I.—HISTORICAL RÉSUMÉ

The study of fossil sponges has been persistently, though not inexplicably, neglected by palæontologists. The Porifera were not even mentioned in the literature until a little over two hundred years ago—and then not by that name—while accurate and detailed investigations of the morphological characteristics and of the skeletal structure were undertaken only within the last forty years. This neglect of the fossil forms is due, first, to the failure of zoologists to acquire an intimate knowledge of living sponges and, second, to the belief held by palæontologists until very recently that fossil sponges could not be studied anatomically and structurally as the recent ones could be and that the only method of approach in description and classification was by the examination of the shape and external form. Since the history of the

recently-developed science of Palæospongiology is intimately connected with the discoveries made in Neospongiology, it is essential to have in mind the important steps in the evolution of the latter science.

RÉSUMÉ OF HISTORY OF INVESTIGATIONS ON RECENT SPONGES

Period from the Days of the Ancients to the Seventeenth Century

As in all branches of natural science one turns to the Father of Science for the first rays of light, so too, in the history of the investigations on sponges one looks to Aristotle. He was the first to recognize the sponges, to comment upon their mode of life and growth, and above all to realize that they were animals not plants. Later writers of the classical period either copied what he wrote or made translations into Latin, but when they attempted to add to what he had done they only fell into error, their chief mistake being to consider the sponges as plants. For more than fifteen hundred years nothing of scientific value was contributed to the few facts established by Aristotle. Beginning with the seventeenth century, the next three hundred years may be divided into four periods, each one of which marked the completion of a certain group of investigations on recent sponges.

Period of Determination of Systematic Position (1600-1750)

The great problem in connection with living sponges during the Middle Ages was the determination of their taxonomic position. Were they plants or animals? Aristotle had placed them in the animal kingdom, but few subsequent writers followed him in this, most of them considering that sponges were plants. Italian authors particularly held to the vegetable nature of these organisms as shown in the writings of Ferrante Imperato (1599), Ulysses Aldrovandi (1606), and de Marsigli (1711). In the century following Imperato the works by English writers all show a ready acceptance of the Italian dictum as in Ray's publications of 1686, 1690, and 1704, in the paper by Sloane (1696), and in that by Plukenet (1696). The earliest attempt to break away from the belief in the vegetal nature of the sponges was made in 1553 by Belon, who assigned to the sponges a position intermediate between plants and animals. In 1635 J. Eusebius Nieremberg came out strongly for the animal nature of sponges, but the idea did not spread very rapidly and for another hundred years they were, as we have seen, generally placed in the plant kingdom. Indeed, in the first edition of the 'Sys-

tema Naturæ' (1735) the genus *Spongia* will be found under the Cryptogamia in the group of the Lithophyta. It cannot be said that any one writer succeeded in convincing his contemporaries as to the true position of the sponges, but we find that they gradually took their place among the animals instead of among the plants, so that by 1750 zoologists began to turn their attention more especially to the anatomy and the description of new species.

Period of Anatomical Discoveries and of Classification (1750-1825)

This period dates from the middle of the eighteenth century, but an account of it would be incomplete without the mention of the experiments and microscopic studies of the skeletal network carried on by Antony van Leeuwenhoek, a brief notice of which appeared in the Transactions of the Royal Society of London in 1706. Leeuwenhoek's contribution consists not so much in the discovery of some single fact, although it is to be remembered that he did make the keen observation that the horny skeleton did not soak up water as was commonly believed, but rather in the introduction of the microscope for the study of the anatomy of living sponges. This great improvement in the method of work was not immediately seized upon by zoologists who were still debating the more fundamental question of broad classification. By 1750, however, the position of the sponges in the animal kingdom was scarcely any longer a subject for controversy and attention began to be turned to the details of structure which the microscope revealed. The spicules were discovered by Donati (1750), the canal system by Ellis (1765), while many observations upon living sponges were made by Schweigger (1819), who discovered the free-swimming larvæ.

As in the development of any branch of science, so it was in the belated study of the sponges—as soon as a certain number of characteristics were discovered which varied for different individuals, just so soon did a crude classification begin to spring up, depending upon the presence or absence of one or more of the characteristics or upon their various modifications. In the dozen and more editions of the "Systema Naturæ," beginning with the first folio edition of 1735, may be traced the steps in the progress of classification. Among the pioneers in the task of describing and arranging in natural order the vast number of living sponges may be mentioned Pallas (1766), Esper (1788-1830), Olivi (1792), Lamarck (1813), and Lamouroux (1816, 1821, 1824).

Period of Detailed Microscopic Studies (1825-1874)

Beginning with the year 1825 the literature on sponges assumes a more scientific terminology: descriptions of species are more accurate; detailed anatomical studies and physiological experiments are made and the results described; and, in consequence of these improvements, classifications are refined. In the production of descriptive works on recent sponges the British investigators formerly stood in the foremost ranks and one need only mention the numerous papers by Grant, the first of which appeared in 1825 and which from time to time for more than three decades continued to help in the unravelling of sponge anatomy and classification; the classical volumes by G. Johnston (1832-1842) culminating in the 'History of British Sponges and Lithophytes' (1842); the many short papers by Carter (1848-1881); and, finally, the three large volumes (including plates) by Bowerbank on 'The Anatomy and Physiology of the Spongidae' (1858-1874). Belonging to this same period of detailed descriptions and refinements of classification are the contributions by Oscar Schmidt, beginning in 1862 and extending over some twenty years or more, the studies by Haeckel on the Calcispongiae, of which the first appeared in 1875, and numerous lesser contributions by French writers, such as those of Dujardin (1838, 1841), and Laurent (1838, 1840, 1844, etc.).

Period of Modern Investigations (1875-present)

This last period opens with the first paper published by Franz Eilhard Schulze in 1875. His method of work has been so thorough and the field of his investigations so broad that he has practically revolutionized the study of living sponges. He was the first to discover the three cellular layers, while his observations on the embryology and the detailed anatomy of sponges leave little to be done by future workers on the ground which he covered. Within the last forty years there have been so many writers on recent sponges in all the European countries that it becomes difficult to mention even a few without seeming to slight many students of equal rank. As the foremost in Germany must be noted Schulze, Haeckel, Keller, and von Lendenfeld; in England, Sollas, Ridley, Dendy, and Marshall; in Holland, Vosmaer; in Russia, Dybowski, Czerniawsky, and Merejkowski; and in America, Alpheus Hyatt (Revision of the North American Porifera; with Remarks upon Foreign Species. Mem. Bost. Soc. Nat. Hist., II, pp. 399-408, 481-554, Pls. XIII, XV, XVI, XVII).

RÉSUMÉ OF THE LITERATURE ON CRETACEOUS SPONGES

Fossil sponges of any age have come under the notice of the palæontologist only within the last two hundred years, while it is only with the beginning of the nineteenth century that we can claim that any contributions of value were made to the literature. In the present discussion attention will be confined almost exclusively to the work done on Cretaceous sponges, but this will cover by far the greater part of the literature on all fossil sponges, since there has been comparatively little written on Palæozoic sponges with the exception of a few standard monographs such as Hall and Clarke's 'Palæozoic Reticulate Sponges' in America, Rauff's 'Palæospongiologie' in Germany, and Hinde's 'British Fossil Sponges.'

In going through the literature on fossil sponges, one is struck with the close parallelism in the development of thought in the study of fossil and recent forms but one sees epitomized in the palæontological literature of two hundred years what is spread out over two thousand years in zoological literature. The besetting difficulty for both groups of investigators was the determination of the best method of work and, until this was discovered, all classifications were unsatisfactory and often artificial. In the case both of living and of fossil sponges the form of the skeletal elements, being least affected by the environment and mode of growth of the organisms, has been found to be the most reliable basis for classification, but it was not until the last quarter of the nineteenth century that this basis was adopted with the refinement that was necessary. It is interesting to note that the method of study of both recent and fossil sponges was revolutionized practically simultaneously, the first of F. E. Schulze's papers appearing in 1875, the first of von Zittel's in 1876.

I shall now give a very brief résumé of the literature which has appeared in Great Britain, France, Russia, Bohemia, and Germany on Cretaceous sponges and shall include an evaluation of the more important books on the subject.

Great Britain

The earliest attempt in England to describe Cretaceous sponges was that made by Parkinson in volume II of his 'Organic Remains of a Former World' (1808). Scattered through the volume are picturesque descriptions of a number of sponges from the Chalk of England, most of which are figured. The descriptions are of practically no value

but, relying upon the illustrations, later authors have included some of Parkinson's species in their synonymies, though usually such a proceeding is rather unsafe. In this first work of his, Parkinson made no attempt to use a binomial system of nomenclature, but in his 'Outlines of Oryctology' (1822 and 1830) he wrote in a much more scientific manner and described several genera with as much precision as was possible at that time.

A noteworthy advance in the description of species was made by Gideon A. Mantell. In 1815 he published a description of a sponge which he called *Alcyonium chonoides* (changed in 1822 to *Ventriculites radiatus*) and gave several very satisfactory illustrations of it. In 'The Fossils of the South Downs' (1822) he described eleven species and figured most of them. Mantell is to be commended for his attempt to distinguish different species, even though he frequently failed in his endeavor and included distinct forms under the same specific name. He recognized that the external form was exceedingly variable in fossil as in living sponges and that one could not rely upon shape in determining species. His illustrations depicted clearly the surface characteristics which were observed and in that respect were superior to many of the figures which appeared in books by later writers.

Phillips in the 'Illustrations of the Geology of Yorkshire' (1829, 1835 and 1875) listed sixteen species of sponges (ten new) from the White Chalk (Senonian) of Danes' Dike in Yorkshire. He gave rather poor illustrations and no descriptions but, because his types were available, many of the species have been described by Hinde and credited by him to Phillips, so that later authors have accepted a number of Phillips' manuscript names.

In 1831 Miss Benett published her 'Catalogue of the Organic Remains of the County of Wilts.' In this she listed forty-seven species and varieties of sponges, thirty-three of which were new. The drawings which she made were very good but she gave no descriptions. Consequently, since her specific names were only manuscript names (chironyms), it has been solely through the courtesy of a few later authors that any of those which she proposed have been credited to her. Michelin, while using her names, took the credit as describer, as he had a perfect right to do, but Hinde in three instances ascribed the species to Miss Benett on the ground that her illustrations could leave no doubt as to the forms she meant.

By far the best descriptive contribution which appeared in the first half of the nineteenth century in England was J. Toulmin Smith's

series of papers 'On the Ventriculidæ of the Chalk' (1847, 1848). In these papers Smith studied the sponges under the microscope, noting differences in the tissue and in the meshes of the network. He failed altogether to make any use of the form of the spicules in the separation of species, but he was at least nearer to the correct method of work than had been his predecessors, who relied solely upon the shape and upon surface characteristics in describing species.

There were a number of writers who described one or two species, or perhaps only figured some specimens, and their names will here be listed without comment since their contributions are of historic interest only: Conybeare (1814), Webster (1814), William Smith (1816), Martin (1828), Rose (1829), Fitton (1836), Lee (described eight new species from Yorkshire, 1839), Bowerbank (1839), Morris (1843, 1854), Dixon (1850), and Tate (described four new species from Ireland and listed eighteen more, 1865).

Among the British workers on Cretaceous sponges there are only two men who stand out as having produced epoch-making contributions to the science; these two are William Johnson Sollas¹ and George Jennings Hinde. The former has written a number of short papers on recent and fossil sponges, as well as the volume on the Tetractinellida in the Challenger Reports, but he has devoted his attention primarily to Cretaceous species. In 1873 he published his first contribution, a short discussion of some of the Ventriculidæ, which is noteworthy as being the first attempt in Great Britain to study fossil sponges in the same way that living ones were studied, that is by a microscopic examination of thin sections with particular reference to the spicules. In time Sollas made a careful investigation of a representative genus of each order of Silicispongiæ, but it was not until 1885 that he finished carrying out his original plan.

Far above all other past or contemporaneous British students of fossil sponges stands Professor G. J. Hinde. As a young man he was attracted to the European center of palæontologic research, the University of Munich, where Professor Karl A. von Zittel occupied the chair of geology and palæontology. Von Zittel, in the early seventies, undertook to monograph all the fossil sponges and by 1880 he had completed his task. It was during the last part of this eventful decade that Hinde went to Munich, taking with him a single and not very bulky nodule from the Chalk of Horstead, Norfolk. The contents of

¹Professor of Geology and Palæontology at the University of Oxford. (Born 1849.)

this one nodule provided him with material for his doctorate dissertation which, as is not at all surprising when we consider how full must have been the Munich air at that time with discourses on sponges, was entitled 'Fossil Sponge Spicules from the Upper Chalk.' The nodule, about a foot in diameter, was found to contain thirty-eight species of sponges, all represented by spicules, which were studied and described by Hinde, under the guidance and supervision of von Zittel. Shortly after Hinde returned to England in 1880 he was asked by the Keeper of the Geological Department of the British Museum to arrange the collections of fossil sponges. He found that so many of the species were new to science or needed to be redescribed that he had to enlarge the plan of procedure first proposed and, with ample funds and plenty of time at his disposal, he finally in 1883 brought out the famous 'Catalogue of the Fossil Sponges in the Geological Department of the British Museum.' All of the types of older British authors, such as those of Toulmin Smith, Phillips, and Mantell, were redescribed and many of them figured, so that foreign workers no longer were forced to depend upon the meagre protologs and sketchy protographs. As was natural, Hinde accepted Zittel's classification almost without change and employed the Munich method of studying and identifying spicules. This catalogue led Hinde on to the monographing of British fossil sponges in a more elaborate and detailed fashion. In 1887 appeared the first part of this Monograph, dealing with Palæozoic species. It contains several general sections, including a résumé of the more important literature on the subject (232 references), an account of the structure and morphological characteristics of fossil sponges and a revised classification. The second part of the Monograph, taking up the systemic discussion of Palæozoic species, appeared in 1888 and the third part, dealing with Jurassic sponges, appeared in 1893, while the volume upon the Cretaceous species is now in preparation. Hinde has done more for British fossil sponges than had all of his predecessors put together and, of living palæontologists,¹ he and Rauff are the two foremost specialists on palæospongiology.

France

The earliest and, in many ways, the most illustrious French palæospongiologist was J. E. Guettard, who wrote several memoirs on fossil sponges and corals (1751, 1768, 1786). He was far ahead of his time,

¹Hinde died March 18, 1918. See Appreciation of him by M. O'Connell, *Science*, N. S. XLVIII, No. 1250, pp. 588-590, Dec. 13, 1918.

both in the accuracy of his observations and in the correctness of many of his conclusions. One very important thing which he realized and which was lost sight of even in his own country for many decades after him was that the fossil sponges are to be compared with living ones and that in their structure and anatomy both are alike. He did not confine himself to the study of the outer form alone, as did his contemporaries, but he made observations on the canal system and upon the spicular network visible on the surface of the fossil sponges. He was, however, of the opinion that the sponges had originally been soft-bodied (presumably, I suppose, horny) and that the hard structures had been developed through the processes of fossilization. Guettard described and figured many species from the Cretaceous of France and some also from the Jurassic.

The works published subsequent to Guettard's memoirs were of little value, and are now only of historic interest. They encumbered the literature with a vast number of specific names, all of which must be taken account of in synonymies, and they introduced artificial classifications which served only to retard, not to advance, the science.

We may pass over as of little importance the brief notices in the 'Dictionnaire des Sciences Naturelles'—published in sixty volumes from 1816 to 1830 under the direction of Cuvier—by de Blainville and Defrance. In the general articles by the former author attention was paid only to the recent sponges and in the scattered notes on the fossil forms by Defrance the descriptions are brief and superficial. Blainville took a step forward in supporting the idea—then forgotten or overlooked by many—that the corals (Actinozoa) and sponges (Amorphozoa) were totally distinct. Even the distinguished Lamarck, in his 'Histoire Naturelle des Animaux sans Vertèbres' (1816, first edition; 1836, second edition), treated the fossil sponges cursorily and held to the opinion that they were closely related to the Alcyonarian corals.

In spite of the fact that Ellis and Sollander in 1786 pointed out the distinctness of the sponges and corals, these two phyla were indiscriminately mixed up by palæontologists for a long time after that. Lamouroux, for instance, in his 'Exposition méthodique des Genres de l'Ordre des Polypiers, des Zoophytes D'Ellis et Solander' (1821) included in his order of Polypiers: Bryozoa, Porifera, rugose corals, and Alcyonarian corals (according to modern terminology). He did not recognize the true distinctions between the various phyla here grouped together either at that time or in his later 'Encyclopédie méthodique. Histoire naturelle des Zoophytes, ou Animaux Rayonnés' (1824).

Hardouin Michelin was another of the truly great French palaeontologists who unconsciously found the sponges a stumbling-block, and followed de Blainville in treating them as a distinct group under the name of Amorphozoa. He described a large number of new species from the Cretaceous of France, but he made no mention of the skeleton, relying wholly upon the form for the determination of species. Furthermore, one cannot rely upon his brief synonymies, because he had a weakness for proposing new specific names and of then making those proposed by other authors synonymous with his own when there was actually no justification for such a procedure.

Alcide D'Orbigny (1849, 1850, 1852) was the first to undertake the classification of fossil sponges as a whole and he divided them all into two groups, *Amorphozoaires à squelette corné* and *Amorphozoaires à squelette testacé*, to the latter of which belonged practically all of the fossil forms. In this second order he recognized five families, using as determinative characteristics the external form and the presence or absence of central opening (i. e., paragaster), epitheca, and openings on surface (i. e., ostia and postica). It is apparent that the value of the skeleton and its elements was not, as yet, recognized and that classification was still based upon practically worthless, because absolutely unreliable, features. But the making of even a poor classification is praiseworthy when no other has been attempted, and we might look back to D'Orbigny with gratitude if he had not proceeded to overshadow his small, but genuine, contribution by a blunder fraught with disastrous consequences for the development of palaeospongiology in France. He believed that fossil sponges had had stony skeletons, not horny ones as many had claimed, and in this opinion he embodied an important truth, but he also thought that recent sponges are not possessed of such a hard skeleton and that, therefore, the two groups were wholly distinct and that nothing was to be derived in the understanding of the fossil forms from a study of the living ones. Thus he took no note of the discoveries being made by zoologists, missing all that he might have acquired in rich suggestions from their work. And, because of his greatness and of the loyalty of his followers in the French school of palaeontology, progress in this field was blocked for two decades, by which time the opportunity to accomplish anything either in broad classification or in the details of structure had passed beyond the borders of France.

The impulse given by D'Orbigny in a wrong direction led to one of those eventually self-destructive orthogenetic lines of development

visible at intervals throughout the history of the biologic world and found no less often in the progress of man than in the evolution of the invertebrates. One such orthogenetic outgrowth was Fromentel's 'Introduction à l'Étude des Éponges Fossiles' (1859). In this work, fifty species (ten new) of Cretaceous sponges from France were described and most of them were figured, although the illustrations were as a rule only copies of those given by Goldfuss and Michelin. An entirely new classification was introduced, based not upon the form, nor the skeletal structure, nor the canal system, but upon the openings visible upon the surface of the sponge. These openings were termed *oscles*, *tubules*, and *pores*; and, according to their size, arrangement, and position, orders, families, and genera were determined. According to the type of opening developed, Fromentel recognized three suborders of sponges: *Les Tubulés*, *Les Osculés*, and *Les Poreux*. The delimitations of families were based upon the presence or absence of different types of openings and, when necessary, also upon the form. Fromentel further conceived a highly artificial nomenclature for the genera, in which all forms in a particular family bore names with a uniform ending, notwithstanding the fact that this necessitated a ruthless disregard of the laws of priority. It was not that he redefined and restricted old genera, for often his descriptions are most meagre; he simply changed the names to fit into his arbitrary scheme. Thus *Cribrospongia* became *Cribroscyphia*, *Cæloptychium* became *Cælochonia*, and *Siphonia* became *Siphoneuda*. The work is of little value and, outside of France, never received much notice, authors not even including Fromentel's names in their synonymies.

In the same year E. Courtyiller attempted to describe the fauna from the Cretaceous of Saumur in Maine-et-Loire in a paper entitled 'Éponges Fossiles des Sables du Terrain Crétacé Supérieur des Environs de Saumur' (1859). In it he described one hundred and thirty-eight "new" species, making every smallest variation in shape an excuse for erecting a new species. A few words suffice for each characterization, but the paper is copiously illustrated with forty plates, which, however, are of no more scientific value than are the descriptions. Practically none of Courtyiller's names have any standing at present, because it has been impossible for later workers to determine what species he was trying to describe and because many of his "species" were only different forms of a single one.

We may mention, at this point, a number of writers who produced descriptive works for small areas but who did nothing to advance the

classification or the better understanding of sponges; they either noted already known species in new localities or described a few new species in the prevailing unscientific manner. Among these are: Faujas-Saint-Fond (1797), Ramond (1801), D'Archiac (1840, 1846*a*, 1846*b*, 1846*c*), Deshayes (1831), Passy (1832), Leymerie (1841, 1842), Marcou (1848), Pictet (1857, sponges listed in 'Traité de Paléontologie'). For complete references, see bibliography.

The next, and last, name to stand out in French literature is that of A. Pomel. He was decidedly handicapped by his geographical isolation, for he carried on his work in the Province of Oran, northern Algeria, with few books at his disposal and no museum collections to study. In 1872 appeared the fifth fascicule of his 'Paléontologie ou description des animaux fossiles de la Province D'Oran.'¹ This section was devoted to the sponges and represented much hard work on the part of its author, who was hampered not alone by the lack of important literature but also by an insufficient knowledge of zoology. Thus, Rauff records that in the zoological section he made no reference to the works of Lieberkühn, Köllicker, Gray, Wyville-Thompson, Carter, Mielucho Maclay, Haeckel, and others, while it was only in the later part of his paper that he referred to Bowerbank, whose volumes had appeared ten years before. For his insistence on the close relation between fossil and living sponges and his attempt to wipe out old classifications, Pomel is to be commended. He made no detailed investigations of the skeletal elements, nor did he figure any, but he did insist upon the importance of the structure of the skeleton in making the large divisions of the phylum. For families, tribes, and smaller taxonomic divisions he was satisfied with the external form and the character and position of the oscula, thus following D'Orbigny and Fromental closely. For the Miocene and other Tertiary faunas his work is very valuable, since it contains descriptions of many new species of sponges from Oran.

One year later Sollas published his short paper on the *Ventriculidæ* of the Chalk (1873) and three years after that appeared the first part of Zittel's monograph which he completed by 1879. This monograph was so revolutionary in its method of treatment of the sponges and so comprehensive that nothing remained to be done except to extend the method to the study of faunas in different countries. The English under

¹I have been unable to see this volume, because so far as I know there is no copy in the United States, unless it be in some private library. I am compelled, therefore, to rely upon Rauff's estimation of the paper. For an excellent account of Pomel's life and contributions to science, the reader is referred to the 'Notice Biographique sur A. Pomel' by M. E. Fichet in the Bull. Soc. Géol. France, 1892, (3) XXVII, pp. 191-223.

Hinde's leadership started in immediately on the fossil sponges of Great Britain, Hinde doing the major part of the work, as we have seen. The German fossil sponges were taken up in even greater detail under Rauff, Kolb, and Schrammen; in Bohemia Frič and Počta, more particularly the latter, monographed the Cretaceous sponges; in Russia the work was carried on by various Germans. But France alone possesses no classic on her abundant Cretaceous sponge fauna; one who would list that fauna would have to include the practically uncharacterized species named by D'Orbigny, Fromentel, Courtiller, and their followers. The only modern contributions on the French sponges are the two by Počta (1892, 1907) and one by Barrois (1898) which are discussed below, pages 65, 66, and 68.

Russia

The Cretaceous sponge fauna of Russia has not been described in its entirety by any one. Local faunal studies have led to the description of a few species in scattered areas, but that is all. The early work by Knorr and Walch (1775) dealt only with the Jurassic species, and the first notice that I have come across of Cretaceous sponges is at a much later date. Fischer von Waldheim's costly and elaborate large quarto volume entitled '*Oryetographie du Gouvernement de Moscou*' appeared in 1837 and contained the description of a single species of sponge, *Siphonia pyriformis* Goldfuss, from the Chalk of Bouchevoë, near Moscow. In the same year appeared '*Polens Paläontologie*' by Pusch, in which the sponges are briefly referred to. This was followed in 1843 by a short paper by Fischer von Waldheim in which were described three new species of *Cæloptychium*, and by a second short paper in 1844 entitled '*Observations sur le Genre de Polypier Cæloptychium*' in which five more new species were described from the Chalk of the government of Simbirsk.

In 1865 the second volume of E. von Eichwald's classic '*Lethæa Rossica ou Paléontologie de la Russie*' appeared and in it were the descriptions of many species of sponges, a large number of which were new to science. They were considered more from the stratigraphic than from the palæontologic viewpoint, the descriptions being brief and without details regarding the structures.

One of the few Russian papers which has appeared on the sponges is that by Sinzow (1872), entitled '*Ueber Jura und Kreideversteinerungen im Gouvernement Saratow*,' but here, too, the sponges are not treated by a specialist; the descriptions are brief and the skeletal structure or

elements are not used in definition. The author has given brief synonymies and seems to have had access to the chief large works on sponges, if not to all the shorter papers. His illustrations are well drawn and excellently reproduced and are to be noted for the care given to the details of the surfaces of the species described, enlargements having been made for each plate.

In 1877 Trautschold described four species from the Cretaceous of Russia, but the descriptions are of only the external characteristics and the illustrations are very poor.

Another stratigraphic paper containing mention of sponges is that by Pianitzky (1890, 'Recherches des Dépôts Crétacés des bassins du Don et des affluents gauches du Dnieper.')

Thus far the Cretaceous sponges of Russia have been considered by stratigraphers and the work done on them has been descriptive but not taxonomic. With the unparalleled development of the chalk in that country there is undoubtedly to be found a large sponge fauna but, so far, the field is practically untouched.

Bohemia

In 1840 August Emanuel von Reuss began his elaborate work which appeared under the title of 'Geognostische Skizzen aus Böhmen' (1840-1844), on the stratigraphy of the Bohemian Mittlegebirge in the neighborhood of Teplitz and Bilin. This was followed in 1845-1846 by a volume on the palæontology entitled 'Die Versteinerungen der böhmischen Kreideformation.' In this he described forty-three species of sponges but, like other Germans at that time, he followed Goldfuss in dwelling only upon external characteristics and his illustrations, though carefully drawn, show only the outer form of the sponges.

In 1869 the Natural History Survey of Bohemia was inaugurated and there appeared at Prague the first volume of the 'Archiv für die naturwissenschaftliche Landesdurchforschung von Böhmen' containing the exhaustive 'Studien im Gebiete der böhmischen Kreide-Formation.' Johann Krejčí (1869) wrote the general stratigraphic section, establishing the geologic succession and giving many detailed vertical and columnar sections, while Anton Frič¹ undertook the palæontological investigations of the individual formations of the Cretaceous, and for forty years there have been appearing in the archives of the Bohemian

¹German spelling, Fritsch.

survey monographs by the latter, these being completed in 1911 with a total of nearly a thousand pages. During this period he brought together, in connection with his studies, a marvellous collection of the Cretaceous fauna and flora of Bohemia, which is to be found in the Barrande Museum (Barrandeum) at Prague of which Frič was curator until his death two or three years ago. The stratigraphy and palæontology have been treated with equal care and with a detail so great that it is highly improbable that future workers will need to make changes of more than minor significance. While the sponge fauna was found to have many species in common with that of northwest Germany, there was also revealed a large proportion of wholly provincial forms which, so far, seem not to have occurred elsewhere. Frič did not essay the complete description of the entire sponge fauna but turned the monographing of it over to his pupil Philipp Počta, in accordance with the general plan of the Natural History Survey to have complete faunal studies made for each phylum.

In Počta's 'Beiträge zur Kenntniss der Spongien der böhmischen Kreideformation,' which appeared in three parts in 1883 and 1884, we find the one standard reference work for the Cretaceous sponges of Bohemia, corresponding to Hinde's 'Catalogue' in England and to Rauff's *Palæospongiologie* for the German Palæozoic and Schrammen's 'Kieselspongien' for the German Cretaceous. Zittel's classification and method are followed and the book will be found to be of especial value in containing the most complete synonymies for the species described that have appeared in any one treatise.

Additional species of sponges have been described from time to time in late years as new discoveries have been made, while already known species have been found in new localities. The more important recent writers are Ceněk Zahálka (1885, 1886*a*, 1886*b*, 1887*a*, 1887*b*, 1888), Jaroslav Jahn (1891), Břetislav Zahálka (1912*a*, 1912*b*, 1913), and Scupin (1907). Ceněk Zahálka wrote only short papers discussing previously named species or calling attention to new occurrences, his work being very local in character and confined mostly to the Cretaceous around Roudnice (German Raudnitz). Many of his papers are short contributions, written in Bohemian and thus rather inaccessible. The stratigraphy of the Cretaceous around Prague has been worked out in the utmost detail by Břetislav Zahálka (1912*a*, 1912*b*, 1913, papers in Bohemian), who has not, however, paid much attention to the faunas, merely mentioning species in the text and listing them in summary tables.

Germany

In spite of the fact that German palæontologists knew of the existence of fossil sponges as far back as 1702 when Scheuchzer's memorable volume entitled '*Specimen Lithographiæ Helveticæ Curiosæ*' appeared, absolutely no mention of Cretaceous sponges was made for over a hundred years, although both French and English writers, especially the former, were publishing at length on Cretaceous species. All of the early contributions by Germans are on Jurassic sponges and it was not until the nineteenth century was well on its way that the Cretaceous rocks and included organic remains came into their own. Then quite suddenly there sprang up in this erstwhile barren field the surprisingly comprehensive '*Petrefacta Germaniæ*' by Goldfuss (1826-1833). Its share in the development of the science of palæontology as a whole is well known but it did an especially great service to the sponges, so long neglected. To be sure, the value of internal structures was not recognized and classification was based largely on external characteristics and form, but the work surpassed what was being published in other countries both in precision of description and accuracy of illustration and it sufficed to do that very necessary thing for all progress—it called attention to the existence of the German Cretaceous and other fossil sponges. While classifications were progressing in other countries and large numbers of new species were being described, practically nothing was appearing in Germany. In 1839 Hagenow, in discussing the faunas and stratigraphy of Rügen, described a few species of sponges, but his contribution was a comparatively small one.

The year 1841 marks the second mile-stone on the road of advancement in palæospongiology. The eldest of the three Roemer brothers, Friedrich Adolf Roemer (1809-1869), published his '*Versteinerungen des norddeutschen Kreidegeiriges*.' Born in the quaint mediæval town of Hildesheim, in Hanover, he was fortunate enough to find himself in the very midst of the most fertile field for Cretaceous sponges that there is anywhere in the world, so far as we know. He collected from localities in Hanover, Braunschweig and adjoining regions, working out the stratigraphic succession as well as describing the fauna. His collections and all of his types are now in the Roemer Museum at Hildesheim in buildings given to the town by Hermann Roemer, the second brother.¹ Many new species were named by F. A. Roemer, but his des-

¹See Obituary by Dr. Sprengell in *Jahreshefte des naturwissenschaftlichen Vereins für das Fürstentum Lüneburg*, XII (1893), 1890-92, pp. 40-42.

scriptions were altogether too brief and his illustrations very poor compared with those given by Goldfuss. Since the Roemer prototypes are all available, it has been possible to redescribe them in modern terminology, and this great service has been performed by Schrammen in his Monograph (1910-12). Roemer's 1841 contribution dealt with the entire fauna of northwest Germany; in 1864 he brought out 'Die Spongitarier des norddeutschen Kreidegebirges' in which he described all of the species of sponges then known from that region, that is 261, distributed through 47 genera. Most of the descriptions were still very brief and Roemer even then made no use of the microscopic features of the sponges.

The period from 1870-75 was marked by the appearance of the descriptions of sponge faunas of various localities. It was at this time that Dr. Clemens Schlüter, former director of the Geologisch-paläontologisches Institut der königlichen Universität zu Bonn, began the publication of his numerous papers on the stratigraphy and paläontology of Münsterland and later of northwest Germany. His chief contributions on the sponges appeared in 1868, 1870, 1872, and 1895. In Saxony, Hanns Bruno Geinitz was studying the Quadersandstein and during the years from 1871 to 1875 he published his memoir, entitled 'Das Elbthalgebirge in Sachsen,' in which he carefully described the sponges of that region giving good synonymies and well executed illustrations. The youngest and most distinguished of the three Roemer brothers, Ferdinand Roemer, more primarily a stratigrapher than a paläontologist, had at an earlier date (1854) published 'Die Kreidebildungen Westphalens' in which the sponges are simply listed. But in 1870 he brought out the monumental 'Geologie von Oberschlesien' to accompany his geological map of Upper Silesia and in this he described and figured the sponge faunas of the district including the fauna of Oppeln. He followed his brother largely and was thereby at times led into error but, for the most part, his descriptions are to be commended for their definiteness and his synonymies, though often including references which were misplaced, yet pointed the way to later authors, for most of the works up to that time, with the exception of those by Schlüter and Geinitz, had contained at most but one or two references in the synonymies. "The Father of Geology in Texas," as Dr. F. Roemer is frequently called, cannot be considered one of the great contributors to paläospongiology, but his name will always be remembered in connection with the Oppeln sponge fauna.

Although slightly out of chronological order, it is fitting to mention at this point a work which might well have been written at a much earlier date so blameworthy was it in all respects. Rauff very truly remarks that, "It was an especial mishap for Quenstedt that the fifth volume of his '*Petrefactenkunde Deutschlands*,' treating of the sponges [1878], should have seen the light of the world at the same time as Zittel's monographs appeared" (Rauff, 1893-94, p. 87). It was indeed a mishap for Quenstedt but, since the book appeared at all, it was great good fortune for science that it came out just at the time when it could do least harm, since Zittel's monographs effectually served to throw into strong relief all of the errors in Quenstedt's volume. Quenstedt formulated and then became completely enmeshed in a highly artificial system of classification, which was incorrect in its fundamental concepts and in every detail of superstructure. His discussion opens with the following novel and startling classification (1878, pp. 6, 7):

Cœlenterata (Corals)

- (1) *Spongiae* (sponges)
- (2) *Sternkorallen* (i. e., the Tetracoralla and Hexacoralla.)
- (3) *Octactinia* (i. e., the Octacoralla, also the Alcyonarian corals.)
- (4) *Favositen* (i. e., the Favositidae).
- (5) *Quallen* (i. e., Hydrozoa).
- (6) *Bryozoen* (Bryozoa).

In the 600-page volume devoted to the sponges he described many new "genera," not taking particular pains to define them because he thought that characteristics suitable for strict differentiation were wanting. He arbitrarily discarded many old generic names and was as ruthless in his disregard of the laws of priority as Fromentel had been. A great number of new "species" was described, these being based upon unimportant external variations. In the delimiting of genera and species he considered form and habitat as of first importance; then the presence or absence of an epitheca was considered; and third the type of surficial meshwork, under which Roemer's two divisions were recognized: the network (*gitterförmiges Gewebe*), and the vermiform meshwork (*wurmförmiges Gewebe*).

Quenstedt's method of treatment and arrangement of subject matter were such as to make the book very difficult to use. The synonymy references are not brought together in one place under each species but are scattered through profuse and often valueless discussions

on unimportant matters, and from the text alone one often is unable to determine which generic and specific combination Quenstedt considers to be correct; this point can be determined only by consulting the descriptions of the plates. No use was made of the finer structures of the sponges or of the skeletal elements. Most of the Jurassic species have been redescribed by Kolb and the Cretaceous ones by Schrammen, the work done by these authors meaning an entire revision. The atlas of illustrations accompanying the volumes shows carefully executed drawings of the form and surficial characteristics of over a thousand specimens of Mesozoic sponges. The Calispongiæ and Silicispongiæ are indiscriminately mixed up, Quenstedt not having had a clear idea of which genera belonged in the two groups.

In the history of palæospongiology the year 1876 will be memorable as the one in which was published the first of Professor Karl A. von Zittel's contributions, namely, that entitled 'Ueber Cœloptychium' (1876a). Ten years previously von Zittel had been appointed to the chair of palæontology at the University of Munich as Oppel's successor, and during the next four decades he raised his science from a position of obscurity to one of enviable prominence in Germany. Among his students and those whose work was directly influenced by him are to be counted the three foremost authorities on fossil sponges: Hinde, Rauff, and Schrammen. Von Zittel not only introduced practically new classifications of recent and fossil sponges but he developed the method of study and laid the foundations for all future taxonomic work. His classification, however, carried the revision of the phylum only down through the genera. He revised, emended, redescribed, and newly described all of the higher taxonomic divisions and erected many new genera. The overlapping of the older generic terminology, particularly that of the early French writers, may be seen by the synonymies given by Zittel under his new genera. Oftentimes there are parts of eight or ten of the older names included under one of the new generic names. But when it came to the species Zittel merely listed, usually without description, a number of representative species of each genus and sometimes he would give one or two synonymous names for the species listed but, on the whole, he did little in the way of revision for the smaller taxonomic groups. He figured the skeletal elements of at least one species under each genus and in so doing made his great departure from his predecessors, who had figured the inconstant and almost valueless external forms of their species but had never studied, described, or figured the spicules. The classification made by Zittel for a whole

phylum and for recent as well as fossil forms has been universally adopted by palæontologists and zoologists and, while detailed studies on species have led to minor changes, they have also served to show how fundamentally accurate was the revision in its essentials. Von Zittel did not plan to end his work on the fossil sponges with this one monograph, which covered the whole field in a comprehensive way; he wished to take up the sponges of each era and thoroughly to revise and systematize the species, but this he was not able to do. He proposed to Dr. Hermann Rauff, then a Privatdozent at the University of Bonn, to collaborate with him, Rauff to do the Palæozoic sponges, Zittel the Mesozoic. Rauff, not without a full appreciation of the immensity of the task, nevertheless, accepted, for the honor of being a fellow worker of Zittel's was great and with such assistance and inspiration as he would receive the work would be less difficult than it would be if he had to undertake it alone. The Professor, however, found himself unable to carry out his plan, but he urged Rauff to go ahead alone. Thus we are brought to another mile-stone in the history of palæospongiology.

Dr. Rauff published the first part of his 'Palæospongiologie' in 1893-94, in the *Palæontographica*, of which von Zittel was the editor. Rauff, throughout the writing and publishing of the monograph, had Zittel's assistance and advice. The bibliography of 650 references and the chapter on the literature were taken from manuscript which had been written by Zittel in 1878 and had been turned over by him to Rauff. And Zittel had made a wise selection in the choice of some one to carry on his work for Rauff, with a thoroughness that calls forth constant admiration, took up the Palæozoic sponges of the world, describing them species by species, illustrating them as individuals and by enlarged views of the spicules, and including complete synonymies and notes on occurrence. In the chapter on the morphology of the sponges the spicules are described and illustrated, enlargements up to 450 diameters being used. The modes of fossilization were exhaustively discussed and abundant evidence was brought forward to show that the condition in which the sponges are found in the rocks is no indication of their original condition, on account of the number of chemical changes that may take place in the preservation of the spicules. Rauff completed the systematic study of the Palæozoic sponges in the succeeding volume of the *Palæontographica* (1894-95.)

The monographing of the Mesozoic sponges fell to two men: Rudolf Kolb, a student of the late Professor Dr. von Koken of Tübingen, and Dr. Anton Schrammen, of Hildesheim. Very little had been done

on the Jurassic sponges since the fifth volume of Quenstedt's 'Petrefactenkunde' had appeared (1878). We have already spoken of that work and have seen how much there still remained to be done for the Jurassic species. Quenstedt's proterotypes were nearly all at Tübingen, so that Kolb was able to redescribe them and to give satisfactory illustrations especially of the spicules; since the broad classification of the sponges had been made by Zittel and since Rauff had covered the literature on the subject and had fully described the structure and spicules, Kolb had only the systematic work for the Jurassic so that his task was far easier than had been that of those who went before him (Kolb, 1910-11).

To a dentist and local collector at Hildesheim, Zittel entrusted the monographing of the Cretaceous sponges. Dr. Schrammen had published four preliminary papers on the Silicispongiæ (1899-1903) in connection with his own collections and with his studies of the types in the Roemer Museum. His papers appeared as contributions (Mittheilungen) from the Museum and no doubt served to attract Zittel's attention to their author. Schrammen collected vast quantities of material from all the famous sponge localities around Hildesheim, nearly all of which he could visit by covering an area not more than 15 km. in radius. He also collected in Braunschweig, in Münsterland, and in Oberschlesien, and visited the museums in these different states. He perfected the methods of cleaning the specimens, etching them out with acid when possible, but often counting on only a needle with which the matrix was scraped away grain by grain. As a result of his careful collecting and of his laborious and painstaking methods in the preparation of the material, the collection in the American Museum is exceptionally valuable.

Schrammen's Monograph deals only with the Silicispongiæ of northwest Germany and the occurrence of species in other regions is not usually given. The chief criticism of the work is that the synonymies are misleadingly incomplete. By the omission of references it is often made to appear that a certain author was responsible for a given generic and specific combination, whereas he had only accepted some earlier writer's revision, reference to which has been omitted by Schrammen. The failure to include all of the occurrences of each species in other European countries also gives a misleading impression, for oftentimes a species appears to be very restricted in its geographical range, whereas in reality it is widespread. These are mistakes of omission; the one great mistake of commission in the Monograph is a deplorably lax usage

of the term *Belegestück*. After a careful study of the types in the collection in the Museum and after an equally careful study of the Monograph, I have found that Schrammen uses *Belegestück* to cover any kind of a type—proterotype, hypotype, or apotype (for definitions, see below, p. 99)—and that more commonly he means by it only typical specimen and not a proterotype as one would naturally infer. For instance, he claims to have in his collection the *Belegestück* of a species the holotype of which is known to be, say, in the University of Göttingen. What he means is that he has collected specimens from the type locality. Again he uses *Belegestück* to refer to the specimens which he has used to further amplify some one else's protograph or protolog. He evidently knew nothing either of Schuchert's or of Buckman's work on types and of their classification. He is no more to be criticized than is any other palæontologist on the Continent, for the nomenclature of types seems not yet to have been adopted outside of America and Great Britain and, even in those countries, many authors make no use of the classification but still speak indiscriminately of types when they mean typical specimens or else, if they use the type nomenclature, they employ it incorrectly, speaking, for instance, of having the holotype and cotypes of a species which very obviously they could not have. Schrammen, thus, is no more lax in his terminology than are many others, but his use of the term *Belegestück* was particularly unfortunate in his labelling of the collection sent to the American Museum, for he called nearly all of the 800 specimens *Belegestücke*, from which one would infer that they were proterotypes, whereas only about one fourth of them are.

I have given the criticisms of Schrammen's Monograph first so that we might pass on to a consideration of its very great value, which should be remembered more than its shortcomings. The only comprehensive works on the German Cretaceous sponges which had appeared before 1910 were those by Roemer (1841, 1864), which were altogether inadequate and out of date. Small numbers of species had been described by different authors, but the Cretaceous fauna as a whole was still in chaos. Schrammen undertook all of the refinement of specific revision which Zittel had not had time to do and altogether described 321 species in 140 genera. He erected many new families and genera and described a large number of new species. The illustrations which he gave far surpass all that had previously appeared. He has given forty plates figuring entire specimens all from carefully prepared photographs and, in addition, he has figured the skeletal elements of all of his new species and of many species described by other authors. He has made

up the first complete faunal lists of the Silicispongiæ of various localities in northwest Germany and also for the region as a whole. He has given lists of species for each horizon and has included tables of the genera zoologically arranged. The work is a treasure-house of useful information on Silicispongiæ and must be placed in that select group of masterpieces in which already repose the monographs by Hinde and Rauff.

CHAPTER II.—MORPHOLOGICAL CHARACTERISTICS OF THE SILICISPONGIÆ

GENERAL ANATOMY

Sponges found in a fossil state are as variable in shape as are living ones and show almost as great a range in size. They occur in the form of discs, platters, vases, tops, balls, and mushrooms and are so inconstant in shape that even within the same species it is almost impossible to use this characteristic in identification. In size they vary from individuals a millimeter in diameter to those a meter and a half across and in height they range up to thirty-nine centimeters and perhaps more.

Fossil sponges belong to the sedentary benthos, being in nearly all cases attached to the sea-bottom or to some object resting thereon. Many Silicispongiæ were supported by a cylindrical stem or peduncle (*Stiel*), which ended basally in root-like proliferations (*Wurzeln*) used for anchoring (e. g., *Ventriculites radiatus* Mantell). When a stem was absent the basal portion of the body of the sponge was provided with such attaching appendages or else the animal rested on the sea-floor without any particular anchoring processes (e. g., *Plinthosella squamosa* Zittel).

The only sponges found in a fossil state are those which possessed a hard skeleton, either calcareous or siliceous, those with a ceratose or horny framework never having been found in the rocks. That the horny sponges should not have been preserved when the remains of organisms apparently equally perishable are found even in Palæozoic rocks (e. g., the graptolites and many crustacea) is explained by the fact that the ceratose sponges have a framework made of spongin which appears from experiment and observation to be very much more perishable than chitin.¹ Since all that remains of the fossil forms are the hard parts, the student of palæospongiology is confined to observations on the canal

¹Rauff, 1891. Ueber Palæospongia præca Bornem. Eophyton u. Th. *Chondrites antiquus* Halimedes & Th. und ähnliche Gebilde. Neues Jahrb. f. Min. Stuttgart, II, pp. 92-104. (Footnote at bottom of p. 98, on spongin and chitin.)

system, when preserved, and on the skeletal structures, which, as we have seen, are the only reliable morphological characteristics available in the determination of genetic relationships and of specific identification.

Fossil sponges undoubtedly possessed a canal system almost as complex as that discernible in living forms but, on account of the vicissitudes attending fossilization, the infiltration of the canals by silica, lime, iron oxide, or other substances, or their complete collapse through pressure in burial, only the larger of the canals are preserved sufficiently intact to be studied and even these are frequently obliterated. In some genera a recognizable canal system seems to have been entirely absent, as in *Callodictyon* and *Farrea* among the Hexactinellidæ and in the Ascones among the Calcispongiae. As in recent so in fossil sponges, there are two sets of canals: the incurrent or epirrhysa (Rauff), passing from the surface to the interior, and the excurrent or aporrhysa (Rauff), passing from the interior and opening on the inner surface or into the paragaster (Sollas). The epirrhysa in living sponges carry currents of water to the flagellate chambers in the body of the sponge wall and the aporrhysa carry the currents thence into the paragaster. After the food particles are abstracted the water is passed out by way of the osculum (*Paragastermündung*) or aperture of the paragaster. In some cases the epirrhysa and aporrhysa cannot be separated, a single set of canals serving the function of both, as in *Aphrocallistes*. The epirrhysa open upon the the outer surface of the sponge in small pores, termed incurrent-canal apertures or *ostia* (Sollas), while the aporrhysa open into the paragaster in oscula or better *postica* (Rauff).¹ The paragaster is flask-shaped, tubular, funnel-shaped or shallow bowl-shaped, or at times it is absent altogether. The ostia and postica must be distinguished from the *dermal* and *gastral* pores, respectively, which are smaller and are found only in the epidermal layer and do not penetrate the mesogloea. The postica, as a rule, are larger than the ostia and differ from them in form, arrangement, and location. (Rauff, 1893-94, p. 124.)

FORM OF THE SKELETAL ELEMENTS

The skeleton of all known fossil sponges is made up of minute mineral particles, usually microscopic in size, composed of either silica or carbonate of lime, and generally termed *spicules* (*Skeletelemente*). The spicules of siliceous sponges are of two types:

¹For a detailed description of the types of canal-systems reference should be made to Zittel (1878, p. 75) and Hinde (1887, pp. 50-54).

I. MEGASCLERES (*Stütznadeln*)—the true skeletal-forming spicules either free or united into a solid structure or skeleton. These can be readily determined under an enlargement of 20-60 diameters.

II. MICROSCLERES (*Fleischnadeln*)—minute spicules scattered only through the fleshy part and never united into solid skeletons. They require an enlargement of 200-300 diameters for their determination. In many fossil sponges they are unknown and probably not preserved.

In structure, the siliceous spicules are built up of concentric layers of colloidal silica, probably always around an axial canal filled with fine, granular organic substance, which sometimes contains foreign materials. During fossilization this canal is often enlarged, in part or throughout, by destruction of the inner layers of the spicule. The calcareous spicule (of calcite) shows more rarely a concentric structure, and the axial canal, when present, is without organic matter.

According to Rauff, all spicules may be classified into the following types on the basis of the number of arms, without reference to their arrangement or to the angle included between the arms:

Polyactines—many-armed (more than eight),
Octactines—eight-armed,
Heptactines—six-armed,
Pentactines—five-armed,
Tetractines—four-armed,
Triactines—three-armed,
Diactines—two-armed,
Monactines—one-armed.

The further classification is made on the basis of the form and termination of the arms, these variations being designated by the following prefixes:

Oxy—simple and gradually tapering to a point, e. g., *Oxytetractine*,
Torn—abruptly pointed, e. g., *Tornodiactine*,
Strongyl—simply rounded, e. g., *Strongylhexactine*,
Tyl—with knob-like termination, e. g., *Tylhexactine*,
Dicho—with forked termination, e. g., *Dichotriactine*.

In spite of the complexity of the spicules in the Silicispongiæ, in contradistinction to their simplicity in the Calcispongiæ, it is possible to reduce all of the types to a few simple fundamental forms. Indeed,

it is probable that all recent and fossil sponge spicules have been derived from three primary types: namely,

- Regular three-rayed forms or *Triods*,
- Regular four-rayed forms or *Tetrazons*,
- Regular six-rayed forms or *Triaxons*.

At present it is necessary to add to these three fundamental types the following, which have not yet been shown to be derivable from any one of the three: namely, uniaxial, polyaxial, and anaxial.

The regular three-rayed spicules are fundamental for the Calcispongiae; the four-rayed and six-rayed spicules for two sharply contrasted orders of Silicispongiae, namely, the Tetractinellida or Tetrazonia, and the Hexactinellida or Triaxonia, respectively.

The uniaxial spicules are alone characteristic of the order Monaxonia, no other type being found in the supporting skeleton of this order. They are further common in the Tetrazonia and Triaxonia, as in the recent and fossil Calcispongiae. The polyaxial and anaxial types are found principally in the Tetrazonia, less frequently in the Monaxonia; they are wanting in the Triaxonia and Calcispongiae.

Although most of the spicules are derivable from the fundamental forms above enumerated, their modifications are extreme, being principally along the following lines:

- (1) Through differentiation of the arms in length, thickness, and form,
- (2) Through suppression of arms,
- (3) Through increase in number of arms as the result of forking,
- (4) Through special modifications of the ends of the arms,
- (5) Through modification of the median knob from which the arms radiate,
- (6) Through peculiar and very variable ornamentation,
- (7) Through other modifications.

It is evident that similar types of spicules may be derived from different fundamental forms by the suppression or, at times, through the division of the rays. Thus, three-rayed types may be derived by the suppression of one ray of the primary four-rayed type or of three rays in the primary six-rayed type. Therefore, the name *Triod* must be taken as referring to the form rather than to the genetic relation of the derivation of the spicule.

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DETAILS OF SPICULE TYPES

It seems advisable and indeed highly necessary to include a systematic classification of the types of spicules since in no text-book or special treatise in English is there any description of all of the recognized types of spicules, nor is there a complete classification with definitions in any single English or German work, despite the fact that all identifications are based primarily, often entirely, upon the determination and proper designation of the form of spicules. Furthermore, Schrammen, throughout his monograph, has referred to the various kinds of spicules without defining them, having counted upon specialists being able to find the definitions in original source books, but this is a tedious process involving much loss of time. Sollas, Rauff, and Hinde are responsible for most of the terms, but their definitions are not compact and are very often buried in a mass of technical detail so that they are not available for ready reference. Some new terms have been introduced by Schrammen but have not been defined at all or else have been described in the text of some protolog where one who had not gone through the whole monograph would be unable to find it. On Plates I-V an illustration is given for each type of spicule, copies being made of the line drawings in Schrammen's text plates of skeletal elements, these being chosen from the illustrations of species represented in the American Museum Collection. On Plates VI-XIV the actual skeletal arrangements are shown as they appear in each genus represented in the Schrammen Collection. These illustrations show the manner of occurrence of the individual spicules and their mode of union into a solid skeleton.

TYPES OF SPICULES

A.—TRIOD (original).—Three equal arms in one plane diverging at an angle of 120° .

General Termination: simply and gradually tapering to a point (*Oxytrioid*) (Pl. I, fig. 1).

Modifications: When arms are not in the same plane but form a pyramid, spicule is designated *Tripod* (Pl. I, fig. 2.).

Modifications in form produced by various curvatures of rays; suppression of one or more rays; forking of rays.

B.—TETRAXON.—Four equal arms arranged so as to extend from center to four corners of a regular tetrahedron. Angle between arms $109^{\circ} 28' 16''$.

I. REGULAR FORMS (REGULARIA)

Caltrop.—Regular type of tetraxon generally tapering to a point (*Oxycaltrop*). This is also an oxytetractine with four equal angles (Pl. I, fig. 3). In the Tetraxonia each arm contains a central axial canal which unites with the others in the center.

Ornamentation

1. *Rays bearing small spines or nodes throughout or at the ends.*
2. *Criccaltrop.*—Rays regularly ringed (Pl. I, fig. 4.).

Modifications

1. *Tetrod.*—Four arms in same plane.
2. *Tetrapod.*—Four arms forming regular pyramid.
3. *One arm of the caltrop suppressed.*
 - a.—Three remaining arms forming regular pyramid (*Tripod*).
 - b.—Three remaining arms in one plane (*Triod*, derived type).
 - c.—Three remaining arms forming a T (*Orthotriod*).
4. *Diactine Type.*—Two arms of the caltrop suppressed.
 - a.—Two remaining arms at right angles (*Orthodiactine*).
 - b.—Two remaining arms at 180° produces a monactine type.
5. *Monactine Type.*—Three arms of the caltrop suppressed.
6. *Arms forked.*
 - a.—Ends of arms forked (*Dichocaltrop*).
 - b.—Forking from center complete (*Oxyaster*).

Triasene.—One arm elongated or changed in form; longer arm called *rhabd* or *rhabdome*, each short arm called a *cladisc* or *cladus*. The three arms together form a *cladome*. (These may be derived from the regular caltrop, but spicules similar in form but diverse in origin may also be derived from the triaxons, as noted below).

Modifications in the Relations of the Cladiscs and Rhabdome

1. *Protriæne*.—Cladiscs and rhobdome form angle larger than $109\frac{1}{2}^{\circ}$ (Pl. I, fig. 5).
2. *Orthotriæne*.—Cladiscs and rhabdome form angle not over $109\frac{1}{2}^{\circ}$ nor less than 90° (Pl. I, fig. 6).
3. *Anatriæne*.—Cladiscs and rhabdome form angle less than 90° (Pl. I, fig. 7).
4. *Mesotriæne*.—Rhabdome prolonged above axial point.

Modifications in the Form of Cladiscs

1. *Oxytriæne*.—Common form; cladiscs regularly pointed. Any of the four preceding types may have this form of cladiscs, and they are then designated in turn: *Proöxytriæne*, *Orthöoxytriæne*, *Anaoxytriæne*, *Mesoxxytriæne*.
2. *Dichotriæne*.—Cladiscs forked once (Pl. I, fig. 8). Types: *Orthodichotriæne*, etc., *Dichoxytriæne*, etc., *Orthodichoxytriæne*, etc.
3. *Didichotriæne*.—Cladiscs forked twice (Pl. I, fig. 9).
4. *Tridichotriæne*.—Cladiscs forked three times.
5. *Trichotriæne*.—Cladiscs three-pointed (Pl. I, fig. 10.) Types: *Orthotrichoxytriæne*, etc., *Ditrichotriæne*, *Tritrichotriæne*, as under preceding.
6. *Phyllotriæne*.—Cladiscs expanded leaf-like (Pl. II, fig. 1). Types: *Orthophyllotriæne*, etc., *Dichophyllotriæne*, etc.
7. *Symphyllotriæne*.—Leaf-like expansions of [cladiscs united into disc or bowl or cup (Pl. II, fig. 2). When simply a disc the form is also called by Sollas *Discotriæne*.

Modifications of the Rhabdome

1. *Triod* (derived type).—Formed by suppression of rhabdome. Special forms resulting: *Dichotriod*, *Phyllotriod*, *Pinakid* (Pl. II, fig. 3). (Pinakid is the symphyllotriæne with rhabdome suppressed, forming a mere disc of silica.)

2. *Amphitriæne*.—A second cladome formed on free end of rhabdome (Pl. II, fig. 4). This may have variously modified cladiscs as defined under 2, 3, 4 above.
3. *Candelaber*.—End of rhabdome branched candelabra-like (Pl. II, fig. 5).

Diæne.—Four-rayed spicule with one cladisc suppressed.

Types: *Prodiæne*, *Orthodiæne*, *Anadiæne*, *Dichodiæne*.

Monæne.—Four-rayed spicule with two cladiscs suppressed.

Types: *Promonæne*, *Orthomonæne*, *Dichodiane*, etc.

II. IRREGULAR FORMS (IRREGULARIA)

Especially characteristic of skeleton of Lithistida. Ends of arms (or clones) variously modified by branching, becoming slit, developing knobs, etc. By means of these modified ends the spicules interlace and become firmly united. These striking types of spicules are called *desmomes* (*desma* of Sollas). The arm end by which the union is effected is called the *zygome*. The method of union by zygomes is designated *zygosis*. *Crepidome* or *crepid* is the name applied to the simple original spicule (single rod or caltrop) which by addition of silica grows into the desmome; accordingly there are *monocrepid* or *tetra-crepid* fundamental forms, having a single canal and four axial canals, respectively, by which the original nature of the crepidome is determined.

Tetracclone.—A desmome of tetraxon or caltrop type (four arms equal). Ends thickened or rooted (Pl. II, fig. 6).

Trider.—One arm or clone of tetracclones of different length or form from the others. (This type parallels the triæne.) The three equal arms or clones constitute the *clonome*, the modified clone constitutes the *brachyome*: a lengthening of the modified arms as in the triæne takes place, but it is often shorter or of the same length as the clonomes, and is otherwise modified.

Modifications in the Form of the Clonome Arms

1. *Orthotrider* (not given by Rauff).
2. *Dichotrider*.—All arms of clonome fork once (Pl. II, fig. 7).

3. *Dilophic tetracclone*.—Only two arms fork.
4. *Monolophic tetracclone*.—One arm forks.

Modifications in the Form of the Brachyome

1. *Amphitrider*.—Parallel of *Amphitriæne*.
2. *Ennomoclone*.—Regular Trider with clones of clonome simple or forked, but with brachyome shortened and generally much thickened or swollen. The forking of the clones is often close to the point of origin, and sometimes only one or two forks, producing irregular forms, with apparently an odd number of clones coming from the center (Pl. II, fig. 8).
3. *Didymoclone*.—Spicule with median rod or *epirhabd* which has thickened or swollen ends from each of which 3 or 4, seldom more, simple or forked clones arise with variously formed zygomes (Pl. II, fig. 9).
4. *Dicranoclone* (Schrammen¹).—Monocrepid desmomes, typically with a basal part which has a thickened button-like, or thick and rounded end, and is furnished with especially strong wart-like elevations, and from which diverge 2, 3, or more, rarely one or four, knobby clones which themselves end in claw-like zygomes. The angle between the clones may be acute or obtuse (Pl. II, fig. 10).
5. *Rhabdocclone*.—Like No. 3, but with additional clones arising between the ends (Pl. III, fig. 1).
6. *Megaclone*.—Large rhabdocclone with few clones (Pl. III, fig. 2).
7. *Rhizoclone*.—Like the preceding, but all the clones arise from a medium curved or irregular stem and are short, irregular and root-like (Pl. III, fig. 3).

¹Schrammen, 1910-1912, p. 65.

8. *Megarhizoclone*.—Very large rhizoclone; this type characteristic of the family Megarhizidæ Schrammen (Pl. III, fig. 4). Similar large monorepid spicules found in the family Corallistidæ have been called by Schrammen *megarhizoclonids*¹ (Pl. III, fig. 5).
9. *Sphæroclone* (Schrammen²).—Desmomes consisting of a spherically thickened base from which diverge 1 to 8 smooth or thorny arms (clones), the ends of which expand into serrated discs. They are characteristic of the family Sphærocladinidæ (Schrammen) (Pl. III, fig. 6). Schrammen thinks that the didymoclone of Rauff may be formed of two sphæroclones united by one of the clones.
10. *Heloclone* (Schrammen³).—Comparatively large, thread-like desmomes with short, saddle-like elevations and pincer-like indentations, more or less curved and hook-like at the ends, and penetrated throughout their entire length by a single axial canal. They unite by zygoxis, the hook-like ends holding on to the saddles and knobs of a neighboring spicule. They are characteristic of the family Helomorinidæ Schrammen (Pl. III, fig. 7).

C.—**TRIAXON**.—Six equal arms cutting one another at right angles. Fundamental for the Hexactinellida.

I. REGULARLY DEVELOPED FORMS

Hexactine.—Arms simple and regular in form (Pl. III, fig. 8).

1. *Orthohexactine*.—Regular form with equal arms at right angles; the fundamental one from which the following are derived.
 - a.—*Oxyhexactine*. Rays regularly tapering to a point (Pl. III, fig. 9).
 - b.—*Tornhexactine*. Rays suddenly pointed.

¹Idem, p. 65.

²Idem, p. 169.

³Idem, p. 129.

- c.—*Strongylhexactine*. Ends rounded (Pl. III, fig. 10).
- d.—*Tylhexactine*. Ends thickened or swollen into button (Pl. III, fig. 11).
- e.—*Discohexactine*. Ends terminated with discs or rosettes (Pl. III, fig. 12).
- 2. *Pinulhexactine*.—One arm thicker than others and beset with appressed, outward-pointing thorns or scales (Pl. III, fig. 13).

Hexaster.—Arms divided.

- 1. *Orthohexaster*.—Arms regularly once or several times divided, points sometimes bent over. This simple fundamental type may be modified as follows:
 - a.—*Oxyhexaster*. Branches regularly tapering.
 - b.—*Tylhexaster*. Ends of arm branches thickened (Pl. IV, fig. 1).
 - c.—*Graphihexaster*. Arms divided in brush-like manner (Pl. IV, fig. 2).
 - d.—*Discohexaster*. With serrated discs or cups at ends of all or of some branches (Pl. IV, fig. 3).
 - e.—*Floricom*. Ends of divisions of arms bent into S-shape, broadened and toothed distally, and arranged in the form of a flower calyx (Pl. IV, fig. 4.)
 - f.—*Plumicom*. Ends of branches of arms of different lengths, curved, and arranged in bell form (Pl. IV, fig. 5).

Lychnisk.—Each of six arms at the proximal point of junction sends out four supporting branches which unite with those of its neighbors (Pl. IV, fig. 6).

II. MODIFICATIONS OF THE TRIAXON THROUGH THE SUPPRESSION OF ONE OR MORE ARMS. These modified spicules are distinguished from others of similar form but diverse origin by the presence of the rudiments of the triaxial cross of the canals.

Pentactine.—By the suppression of one arm of the Triaxon a *Pentactine* is formed (Pl. IV, fig. 7).

- 1. *Pinulpentactine*.—One arm elongated and beset with thorns (Pl. IV, fig. 8).

2. *Tetræne*.—One arm suppressed, opposite arm elongated.

Tetractine.—By the suppression of two arms of the Triaxon a *Tetractine* is formed, in which the following modifications may take place:

1. *Triæne*.—Three short arms and one long arm, not in same plane. Identical in form but not in derivation with Tetraxon triæne.
2. *Stauractine*.—Tetractine spicules with four arms in the same plane (Pl. IV, fig. 9).

Triactine.—Three arms of Triaxon rudimentary or suppressed.

1. *Diæne*.—One long arm and two short arms arranged anchor-shape.

Diactine.—Four arms rudimentary or suppressed.

1. *Amphidisc*.—Diactines with two opposite arms capped by divided umbrella-shaped discs; other arms aborted (Pl. IV, fig. 10).
2. *Amphiaster*.—Both ends of opposite arms divided into spines; other four arms aborted (Pl. IV, fig. 11).
3. *Uncin* or *Oncin*.—A spindle-shaped diactine, beset throughout its entire length with numerous small thorns (Pl. IV, fig. 12).
4. *Orthodiactine*.—Two remaining arms of diactine at right angles to each other producing a monactine type.

Monactine.—Five arms suppressed.

1. *Tylostyle* (derived form).—Rhabd with rudiments of suppressed arms forming a knob at one end. Rudimentary arms recognizable by axial canals.
2. *Scopula*.—A long rhabd with 2, 3, generally 4, occasionally 5, 6, or more, outward divergent branches at one end, which are thickened distally and often barbed (Pl. IV, fig. 13). These branches are not modified arms because the axial canals do not extend into them, but form a cross at or below the point of divergence of the branches.

3. *Clavula* or *Clavule*.—One end of rhabd pointed, other with backward-bending, umbrella-shaped disc or ring of branches which are not the modified arms, as shown by the position of the cross in the axial canals (Pl. IV, fig. 14).

D.—MONAXON.—Straight or variously curved spicules with single axis or two axes in opposite directions; other axes rudimentary or absent.

- I. MEGASCLERES.—Monaxon megascleres are designated by the general name *rhabd*.

According to Origin

1. *Monactine*.—Rhabd growing from one end only; ends different in form.
2. *Diactine*.—Rhabd growing from center in opposite directions; ends generally, but not always, similar.

According to Form and Termination of Rhabd

1. *Amphiox*.—Rhabd regularly tapering towards point at both ends (Pl. V, fig. 1).
2. *Amphitorn*.—Ends of rhabd suddenly pointed (Pl. V, fig. 2).
3. *Dor*.—Lance-shaped rhabd. One end regularly pointed, the other spear-shaped with 2 or 3 sharp edges. Two ends separated by a ring or annular growth (Pl. V, fig. 3).
4. *Amphistrongyle*.—Rhabd rounded at both ends (Pl. V, fig. 4).
5. *Style*.—Rhabd rounded at one end, tapering to point at other (Pl. V, fig. 5).
6. *Tylostyle*.—Pin-shaped with button-like knob at one end, pointed at other (Pl. V, fig. 6).
7. *Amphityle*.—Rhabd thickened or button-like at both ends (Pl. V, fig. 7).
8. *Ophirhabd* (Schrammen¹).—Long, smooth monaxons of irregular or snake-like curvature, generally tapering towards both ends. They are characteristic of the family Ophiraphididæ Schrammen in the order Tetraxonia (Pl. V, fig. 8).

¹Schrammen, 1910-12, p. 119.

According to the Ornamentation of the Rhabds

1. *Cricorhabd.*—Rhabd with rings or thickenings at intervals.
 - a.—*Cricostyle*. A style with knobs at intervals.
 - b.—*Cricamphityle*. An amphityle (knobbed at both ends) with rings throughout entire length (Pl. V, fig. 9).

II. **MICROSCLERES.**—The small non-supporting, straight or curved spicules or microscleres occur singly or in bundles (*drax*).

Simple Forms

1. *Rhaphid.*—Slender, whip-like spicule.
2. *Tox.*—Bow-shaped spicule.
3. *Labid.*—Spicule shaped like sugar tong.
4. *Spirule.*—Simple, spirally-wound spicule, with more than one volution (Pl. V, fig. 10).
5. *Sigmaspire.*—A small s- or c-shaped, curved and spirally-wound spicule (Pl. V, fig. 11).
6. *Sigma.*—An S or sigma-shaped spicule.
7. *Sigmatoid.*—A C-shaped spicule.
8. *Diancistra.*—S or C-form, with knife-shaped ends, hooked; middle notched (Pl. V, fig. 12).
9. *Chela (Amphichela).*—C-form, with two or more shovel or hook-shaped, sharply recurving teeth at ends. Characteristic of Desmacidonidæ.
 - a.—*Anisochela*. Both ends dissimilar (Pl. V, fig. 13).
 - b.—*Isochela*. Both ends similar (Pl. V, fig. 14).

Ornamented Forms

1. *Diaspid.*—Ends with small shield, often toothed (Pl. V, fig. 15).
2. *Sanidaster.*—Rhabd a thick shaft with rosettes or spicules at intervals and at ends. Sometimes intermediate spines scattered along rhabd (Pl. V, fig. 16).
3. *Spiraster.*—Gently spiral, thorny rhabd (Pl. V, fig. 17).
4. *Discorhabd.*—Short rhabd, pointed at one end, spiny at other, with several toothed disc-like expansions between (Pl. V, fig. 18).

E.—ANAXIAL AND POLYAXIAL SPICULES

1. *Sphær*.—Spherical or ball-shaped spicule (Pl. V, fig. 19).
2. *Euaster*.—Small spherical center with comparatively long radiating spines (Pl. V, fig. 20).
3. *Sphæraster*.—Large central ball with short spines (Pl. V, fig. 21).
4. *Pyncaster*.—Spines blunt, not sharply distinct at base, coming from central ball (Pl. V, fig. 22).
5. *Sterraster*.—Ball with short blunt knobs formed of confluent spines (Pl. V, fig. 23).
6. *Rhax*.—Like preceding, but center kidney-formed (Pl. V, fig. 24).

ASSOCIATION AND UNION OF SPICULES IN THE SILICISPONGIÆ

A.—PRINCIPAL OR SUPPORTING SKELETON (STÜTZSKELET). This is primarily confined to that part of the mesogloea which contains the ciliated chambers (*choanosome*).

- I. MONACTINELLIDA.—In this order four types of arrangement of spicules have been observed. (1) Spicules irregularly scattered, ends united only by spongin; (2) spicules forming triangular meshes; (3) spicules radially arranged; and (4) spicules intercrossed in net-like arrangement.
- II. TETRACTINELLIDA.—Arrangement of spicules radial or irregular. Dermal triænes with rhabdomes pointing inward and cladomes tangential to surface.

In the *Choristida* (choristid type), the spicules are chiefly smooth caltrops, triænes and amphioxes; free (only in a single case united by spongin).

In the *Lithistida* (lithistid type), the desmomes are generally closely joined by their ends, so as to form solid skeletons but no actual fusion of elements occurs (a single recent form has desmomes joined by spongin, according to Sollas). Junction may be irregular or may produce regular structures.

III. HEXACTINELLIDA

Classification According to Method of Union of Spicules

Lyssacina.—Spicules not generally firmly united, being either distinct or closely placed; sometimes hold on to one another by various modifications, or their arms interlace. Touching ends sometimes joined by superimposed siliceous lamellæ, or surrounded and joined by siliceous annuli. Some full-grown individuals have their spicular ends fused, as in the next division.

Dictyonina.—Normally spicules united by regular apposition of arms of adjoining spicules, and union of these is by a layer of silica; original distinctness of spicules recognizable only by observation of separate axial canals. The method of junction produces a regular skeletal scaffold or lattice work (*Dictyonalgerüst*) each bar of which consists of two united arms of adjoining spicules (Pl. XII, fig. 4). A transition to the preceding type is formed by the presence of irregularly placed and joined spicules.

Classification According to Function, Position and Arrangement of Spicules. The spicules of the Hexactinellida have been classified by F. E. Schulze on the basis of function, position and arrangement (not to be confused with classification on basis of form) as follows:¹

1. *Principalia* (*principal*).—Spicules forming supporting skeleton of the *Lyssacina*.
2. *Dictyonalia* (*dictyonal*).—Spicules forming supporting skeleton of the *Dictyonina*.
3. *Parenchymalia* (*parenchymal*).—All the spicules in the soft tissue except dermal and gastral ones (see below).
4. *Prostalia* (*prostal*).—All larger spicules which project above the outer surface of the sponge. They may be:
 - a.—*Basalia* (*basal*). Long, hair-like or thickened spicules projecting from the base of the sponge and used for anchorage.

¹Schulze, F. E. 1886, Ueber den Bau und das System der Hexactinelliden. Abhl. könig. Akad. der Wissenschaften, Berlin, pp. 24-32; 1887, Report on the Hexactinellida, Challenger Reports. Zoology, pp. 40-46.

- b.—*Pleuralia* (pleural). Spicules projecting from side-wall of sponge.
- c.—*Marginalia* (marginal). Spicules projecting free around the osculum of the sponge.
- 5. *Comitalia* (*comital*).—Very thin, long drawn-out needles, closely adjoining the strong *principalia* in the *Lysacina*.
- 6. *Dermalis* (*dermal*).—Confined to dermal membrane. These with the *prostalia* or these alone form the dermal skeleton.
- 7. *Gastralia* (*gastral*). Confined to gastral membrane (*paragaster*). Form gastral skeleton.

B.—SURFICIAL OR PROTECTIVE SKELETON (SCHUTZSKELET). These skeletons are formed chiefly on the dermal surface in the outer layers of the mesogloea and in the ectoderm (ectosome), more rarely on the inner or gastral surface.

Dermal skeleton (*Dermalskelet*). These are common and are very important in systematic work; often differences in them constitute the only mark of generic distinction when the supporting skeletons are entirely similar. They are, however, rarely preserved in the fossil forms, generally because they are minute (microscleres), but sometimes they are larger than the spicules of the supporting skeleton. Their arrangement is irregular or in regular series or groups. In the matter of arrangement there is no relation between the supporting and protective skeleton. Dermal spicules generally project beyond the surface of the sponge (*prostal*), giving it a rough, bristly, hairy or velvety character, in proportion to the amount of projection. More rarely do they form a smooth surface if the spicules or their cladomes (in the triænes, tetrænes, etc.) assume an arrangement parallel to the surface. Sometimes, in connection with foreign bodies, such as sand grains, spicules of other sponges, etc., they make a solid cortex.

The Blanket Layer (*Deckschicht*) or *epiderm and Blanket Net* (*Deckgespinst*) or *dictyoderm*. In many fossil siliceous, as well as in calcareous, sponges a continuous *blanket layer* covers the lower part and sometimes the entire sponge. In this, separate elements have rarely been determinable (see *Ventriculites*, etc.). Rauff holds that these blanket layers are due to

secondary refilling of the pores and inter-spicular spaces by mineral matter, and the accompanying destruction or metamorphosis of the spicules. In other cases (many Hexactinellida, etc.), the blanket layer consists of separate, more or less closely packed, individual elements of similar form which appear to be modified or enlarged spicular ends (1893-94, p. 183). Sometimes the blanket layer (epiderm) is formed by a modification of the outer part of the supporting skeleton, chiefly through thickening of the outer spicule ends (*Callodictyon*, etc.).

A net-like, surface-covering with the parts often raised, is found on the paragastral surface in the Ventriculitidæ, Sporadiscinidæ, etc., and constitutes the blanket net (*Deckgespinst*) or dictyoderm. This is a derivative of outward-directed lychnisk rays of the paragaster surface. In form the net is scale-like or tussock-like.

CHAPTER III. SUMMARY OF THE STRATIGRAPHY OF THE UPPER CRETACEOUS FORMATIONS OF EUROPE

INTRODUCTION

The Cretaceous system was first studied and subdivided by a number of British geologists during the early decades of the nineteenth century, the pioneer in these investigations being William Smith, who from 1815 to 1821 mapped the entire series of Mesozoic strata in England, established the sequence of formations, and enumerated and carefully figured the diagnostic fossils from successive horizons. John Middleton (1812), Thomas Webster (1814, 1824), and W. Fitton (1824, 1836) made important contributions toward the solution of the early problems of classification and correlation of the different divisions of the Cretaceous but to Smith belongs the credit of the recognition of the correct stratigraphic succession in its broad aspects, as may be seen from the following sequence which is the one given by Smith in 1819 and in a less complete form in 1815:

Chalk	} Upper Chalk
	} Lower or Grey Chalk
Greensand	
Golt or Brickearth	

The fact that subsequent investigators have not altered the order of succession then established and the formation names then proposed testifies eloquently to the accuracy and keenness of observation of the "Father of Historical Geology." The formation names proposed by Smith and his followers were lithological terms and in that respect were unsatisfactory, though perfectly in accord with the usage of that time. Later researches in Great Britain have been directed toward the establishing of palæontological zones, the working out of structure and of underground geology, the tracing of lithological variations in the formations, and the correlation of the beds with the Continental equivalents. (See Jukes-Brown, 1900, 1903, 1904, and bibliography at the end of series in volume for 1904.)

In France a lithological and faunal succession closely paralleling that in England was recognized by D'Orbigny, who, however, introduced a series of locality names to replace the lithological terms proposed by Smith, thereby rendering an inestimable service to stratigraphy. In the 'Paléontologie Française,' II, 'Terrains Crétacés' (1842), D'Orbigny divided the Cretaceous into the following six stages in descending order:

ÉTAGES	DERIVATION OF TERMS
SENONIEN	<i>Senones</i> , Latin for Sens, in Yonne.
TURONIEN	<i>Turonis</i> , the ancient Touraine.
CENOMANIEN	<i>Cenomanum</i> , Latin for Mans, in Sarthe.
ALBIEN	<i>Alba</i> , Latin for Aube.
APTIEN	Apt, a city in the department of Vaucluse in Provence.
NEOCOMIEN ¹ s. str.	<i>Neocomum</i> , Latin for the village of Neuchâtel in Switzerland.

While the names of these *étages* are still very generally used, they are being replaced in France by newer terms which have been introduced to refer to shorter time periods, or else the original name has been retained, but the epoch for which it was proposed has been subdivided into a number of stages as in the case of the Senonien which is at present divided into five *étages*. Thus, though D'Orbigny's nomenclature has been modified by the introduction of restrictions and refinements in classification, nevertheless, every one of the names which he proposed is

¹This name was proposed by Thurmann in 1835, but he used it in a broader sense.

in use and they have all been accepted by the Germans and, though to a less degree, by the English, who still generally employ the confusing lithological terms.

In Germany, as in England, the earliest classification of the Cretaceous formations was made upon the basis of the different lithological units recognized. Thus we find in the writings of H. B. Geinitz, F. H. Roemer, and A. E. Reuss, which appeared from 1840 to 1846, many names which have persisted in the literature to the present day, such as Hilssandstein and Hilsthon, Quadersandstein and Plänerkalk. But it is now recognized in Germany that the rocks which were thus variously designated are only particular facies representatives of local development. D'Orbigny's nomenclature is used in the main, though for the Lower Cretaceous the later French modifications have been adopted and for the Upper Cretaceous the Senonien has been restricted by the introduction of the Emscher as a division coördinate with the Cenomanien, Turonien, etc., and by the addition of the Danien as the highest stage of the Cretaceous.

For Europe as a whole the general classification of the major subdivisions of the Cretaceous is as follows:

	FRANCE, BELGIUM SWITZERLAND, SPAIN, ETC.	GERMANY	ENGLAND
UPPER CRETACEOUS	Danien Senonien Turonien Cenomanien	Dänische Stufe { Senon Emscher Turon Cenoman	} Upper Chalk Middle Chalk Lower Chalk ²
LOWER CRETACEOUS	Albien Upper Neocomien { Aptien Barrémien Neocomien { Hauterivien Sens. str. Valanginien	Gault or Aube Stufe Hils or Neokom Weald	Gault ¹ and Upper Greensand Lower Greensand Weald

¹The English have recognised that the Gault and Upper Greensand, which were originally supposed to be distinct and consecutive formations, are in large measure replacing facies of deposits of the same age. They have, however, considered that there were certain Upper Greensand beds which were higher than the highest Upper Gault and that these beds were not anywhere represented by the Gault facies but were, in fact, deposited after Upper Gault time. Such are the Warminster beds and all greensands containing *Pecten asper* and *Cardiaster fossarius*. Recent studies which I have made have convinced me that these highest "Upper Greensand" beds are only facies representatives of the Lower Chalk and should not be included in the stratigraphic series under the Albien. (The details of this problem will be given in a paper now in preparation.)

²Including the highest Upper Greensand, i. e., the Warminster beds, etc.

STANDARD STRATIGRAPHIC SUBDIVISIONS UPPER CRETACEOUS WITH GERMAN EQUIVALENTS

STANDARD STRATIGRAPHIC SUCCESSION		AMMONITE ZONES ¹ (APPLICABLE FOR MOST OF EUROPE)	GERMAN STRATIGRAPHIC EQUIVALENTS
UPPER CRETACEOUS	SENONIAN	DANIAN	<i>Hercoglossa danica</i> Dänische Stufe
		MESTRICHTIAN	<i>Parapachydiscus neubergicus</i> <i>Bostrychoceras polyplocum</i> Obersenon or Mucronatenkreide ²
		CAMPANIAN	<i>Hoplites vari</i> <i>Mortoniceras delawarensense</i> <i>Placenticeras bidorsatum</i> Untersenon or Quadratenkreide ²
		SANTONIAN	<i>Placenticeras syrtale</i> <i>Mortoniceras tezanum</i> Marsupitenkreide or Granulatenkreide ²
		CONIACIAN	<i>Mortoniceras emscheris</i> <i>Barroisiceras haberfellneri</i> Emscher ³ or Westfalicuskreide ² or Oberquader
		TURONIAN	<i>Acanthoceras deverianum</i> <i>Acanthoceras ornatissimum</i> <i>Acanthoceras bizeti</i> <i>Mammites nodosoides</i> Turon or Ober-pläner or Mittlerquader { 5. Cuvieriplän 4. Scaphitenpl 3. Galeritenpl 2. Brongniarti 1. Mytiloides
		CENOMANIAN	<i>Acanthoceras rhotomagense</i> <i>Acanthoceras mantelli</i> Cenoman or Varianspläner (Unter- or Unterquader

¹After de Grossouvre

²Name given by Stolley

³Name given by Schlüter

⁴Zones recognized by Schlüter for the Cenomanian

⁵Von Strombeck's subdivisions and nomenclature

⁶Schlüter's subdivisions of the Turonian

⁷Zones established by G. Müller

NTOLOGICAL ZONES OF THE EUROPEAN
LEMENTS FOR COMPARISON

OR PALÆ- OLOGICAL ONES	PALÆONTOLOGICAL SUBZONES
<i>lla mucronata</i>	<i>Scaphites constrictus</i> , <i>Trigonosemus pulchellus</i> , <i>Bostry- choceras polyplocum</i> <i>Epiaster gibbus</i> and <i>Micraster glyphus</i>
<i>iaz quadratus</i>	<i>Actinocamax quadratus</i> <i>Scaphites binodosus</i>
<i>es testudinarius</i> and <i>nax granulatus</i>	<i>Marsupites testudinarius</i> <i>Uintacrinus westfalicus</i> <i>Inoceramus cardissoides</i>
<i>nax westfalicus</i>	<i>Inoceramus haenleini</i> ⁷ <i>Inoceramus digitatus</i> ⁷ <i>Inoceramus involutus</i> ⁷ <i>Inoceramus koeneni</i> ⁷
<i>amus cuvieri</i> <i>iles geinitzi</i> <i>les (Echinoconus)</i> <i>bogalerus</i> <i>amus brongniarti</i> <i>amus mytiloides</i> <i>= labiatus)</i>	4. <i>Inoceramus cuvieri</i> and <i>Epiaster brevis</i> ⁸ 3. { <i>Heteroceras reussianum</i> } c. <i>Micraster cortestudinarium</i> and { } b. <i>Neoptychites peramplus</i> 3. { <i>Spondylus spinosus</i> } a. <i>Micraster breviporus</i> 2. <i>Inoceramus brongniarti</i> and <i>Prionotropis woolgari</i> 1. <i>Inoceramus labiatus</i> and <i>Mammites nodosoides</i>
<i>eras rhotomagense</i> and <i>Holaster subglobosus</i> ⁴ <i>ichia varians</i> and <i>Hemiaster griepenkerli</i> ¹ <i>uper</i> and <i>Catopygus carinatus</i> ⁴	

Throughout Europe there has been carried on during the last few decades the most profound and minute study of the palæontological zones in the Cretaceous. As in all such faunal work, the cephalopods, being pelagic, are considered the most reliable in the establishing of zones of limited vertical but wide horizontal extent, for which reason the standard zonal subdivisions of the Cretaceous are based upon the ammonites. Following the method which was inaugurated by Oppel in his memoirs on the Jurassic, A. de Grossouvre, W. Kilian, and C. Jacob have established an ammonite succession which is applicable for the greater part of Europe, though many of the zones are missing in the north as in Russia and northern England where local successions have to be employed. In many regions it has been found practicable to make use of phyla other than the cephalopods; thus, in England half of the zones are characterized by echinoderms; in Germany the Cenomanian contains at times pelecypods or echinoderms which are entirely as diagnostic as the ammonites, which may or may not be present, while the Turonian may be subdivided on the basis of the pelecypods, or the ammonites, or the echinoderms, and the Emscher and Senonian show a clear succession of belemnite zones which are of more than local applicability. In order to have for ready reference the general scheme of the succession of stratigraphic divisions and faunal zones for the Upper Cretaceous of northwest Europe, the following table is included.

The Cenomanian and Turonian, together with the Albian which precedes these, are classed by Haug in his text-book (1910, II, p. 1170) as Middle Cretaceous (*Mésocrétacé*), for he recognized a three-fold subdivision of the period. This practice is not common in Europe and does not accord with the American usage, according to which the time period designated by Europeans as Lower Cretaceous is called the Comanchic, while the European Upper Cretaceous is our Cretacic proper. In view of the fact that the Cenomanian marks the great transgression of the Cretaceous, it would seem that the diastrophic evidence favors the two-fold division, which is the one generally accepted and the one which will be adopted in this paper.

UPPER CRETACEOUS PROVINCES OF EUROPE

Despite the persistence of certain comparatively small positive elements which were dominantly emergent land masses or ridges and areas of non-deposition during the Upper Cretaceous, there can be little doubt that the greater part of Europe was covered by the marine or non-marine sediments of that period, and that it was the subsequent

domings and prolonged erosion, largely in early and middle Tertiary time which gave rise to the present isolated outcrops. The scattered patches of Cretaceous strata now visible in Europe are structural, not lithological, units, being in some places the eroded rim of a basin, in others the escarpments developed by the erosion of a dome, and, again, there are areas where the strata have been but slightly disturbed and, in their horizontal position, have been protected by later formations, as in the plains of Hanover. These various structural units are generally considered as distinct provinces, because the lithological and faunal characters of the rocks are often quite distinct in them and, the connecting formations with their transitional facies and organic remains being absent through post-Cretaceous erosion, there is produced a lithological diversity more apparent than real. Of such structural provinces eleven major ones may be recognized.

(1) Great Britain

The Upper Cretaceous of the British Isles consists almost wholly of chalk, on which account the rocks of that period have for over two hundred years been designated the Chalk.¹ This formation, which is the depositional equivalent of the Cenomanian, Turonian, and Senonian of the Continent, and which was at first thought to be so uniform that no stratigraphic subdivisions could be recognized in it, has proved, on long study by British geologists and palæontologists, to be marked by pronounced lateral variations so that in some places it is not a chalk at all but a marl, a pure quartz sandstone, a conglomerate, or a greensand. Generally speaking, the formation is most impure in the lower part, where there is a considerable admixture of siliceous and other detrital materials, but becomes almost wholly calcareous in the upper part. However, one of the coarsest boulder conglomerates known from the Chalk is at the base of the Senonian in Ireland, so that the general rule for gradation in purity does not always hold, yet, on the other hand, the occurrence of elastic material in the higher divisions of the Chalk does not vitiate the truth of the generalization and can easily be explained, as we shall see when we consider the stratigraphic relations.

¹The word is derived from the Saxon *cealc* from which also comes the present German form *Kalk*. Even at the present time the country folk in Lincolnshire call the rock *kalk*, but in the southern counties the word is softened to chalk (Jukes-Brown, 1900, p. 14). Since the Germans applied the term *Kalk* to any limestone, while the British reserved the name chalk for the particular foraminiferal limestone which is commonly understood when we speak of chalk, the Germans had to introduce a new name for this latter rock and have called it *Schreibkreide*. When they use *Kreide* as a formation name, they use it as synonymous with Cretaceous; as a lithological term, *Kreide* means limestone, not chalk.

The present outcrop of the Chalk in the British Isles is but a skeletal picture of its former extent, the main line of exposure extending from Devon to Yorkshire with a broad eastward-projecting tongue formed by the Wealden anticlinal.¹ In the Isle of Wight a sharp anticline has exposed the most complete section of the entire Cretaceous that is found anywhere in England, the Chalk alone here reaching a thickness of 1600 feet, which is the maximum development in England for the formation as a whole. A narrow band of the Chalk rims the Antrim basin in north-east Ireland, where the beds are preserved beneath the great Tertiary volcanic plateau, a position which is likewise held by the outcrops on the opposite coast of Scotland on the island of Mull and on the neighboring mainland in the peninsula of Morvern.

The present topography of the Chalk escarpment is the result of Tertiary and recent erosion. During early Lower Cretaceous time practically the whole of Great Britain was dry land, subject to erosion except in the extreme south and southeast where the continental deposits of the Wealden were forming. Towards the end of the Lower Cretaceous there began that advance of the sea which in its wider expression is known as the great Cenomanian transgression, a positive eustatic movement which, with only slight interruptions, continued into Senonian time. The sea entered southern England from the south, and Yorkshire and Lincolnshire from the east, spreading, respectively, northward and westward. The basal series of deposits accumulated in these advancing seas is always sandy or conglomeratic and contains much glauconite. From the method of deposition it is apparent that this siliceous-glauconitic facies is a lithologic not a chronologic unit, so that it is not surprising to find it of Aptian age in southeast England, of Cenomanian age in southeast Antrim, Ireland, and of Senonian age in northern Antrim. In the greensands and conglomerates thus formed, siliceous sponges abound, though often their presence is shown only by the immense numbers of spicules which are found. Following the sandy facies the beds usually become marly and then impure, and finally pure, chalk. Sometimes the facies transitions are very rapid, taking place within a few feet as, for instance, in northern Antrim where Senonian chalk containing 98% CaCO_3 is found only twelve feet above the thin one-foot basal conglomerate which rests upon the eroded Triassic surface. Sponges are there found in the conglomerate as well as further up in the pure chalk. The highest chalk which is now found in

¹The Weald anticlinal is composed of four distinct anticlines.

Ireland is that of the zone of *Belemnitella mucronata*; the highest in England belongs to the zone of *Ostrea lunata* and is probably to be considered Mæstrichtian in age. Thus there are no remnants of the latest Cretaceous deposits in Great Britain and whether they were never deposited or whether their absence is due to erosion we cannot tell. But we do know that toward the end of the Cretaceous the sea began to retreat in response to a slow doming which was in progress and which had its center of elevation in North Wales and the present Irish Sea. During the Palæocene the dome was peneplaned, the Cretaceous rocks being stripped back entirely from the central region in Wales, while the alternating hard and soft bands now composing the Worcester lowland, the Cotswold Hills, the Oxford lowland and the Chiltern Hills or Chalk Escarpment were exposed by erosion on the flanks of the dome, though the present expression as escarpments and lowlands is due to the subsequent Tertiary erosion of the revived and reëlevated peneplane which cut down the Welsh dome.¹

The following detailed stratigraphical subdivisions and palæontological zones of the Upper Cretaceous are recognized in England, where, however, it is customary to include the Upper Cretaceous Greensand and Gault, which are of Albian age in that period, although Continental workers are practically unanimous in placing the Albian in the Lower Cretaceous. (Table, p. 56.)

In the Cretaceous rocks of Great Britain no siliceous sponges are known below the horizon of the Upper Gault (Albian) or zone of *Schloenbachia inflatus*, which is classed by Continental geologists with the Lower Cretaceous but is placed by the British in the Upper Cretaceous. The Folkestone beds (Upper Gault) of the Sussex coast have yielded a single species, *Siphonia tulipa* Zittel, which is found also in the Blackdown and Haldon beds in Devon but disappears in the lower Cenomanian. In the Malmstone (zone of *Schloenbachia inflatus*) of Devon and of the Isle of Wight, *Jerea websteri* Sowerby has been found and, at Blackdown, *J. reticulata* Hinde. These three species constitute the sole siliceous sponge representation for the Lower Cretaceous of England, if we consider the horizon of *S. inflatus* as belonging to that period and not to the Upper Cretaceous. If, on the other hand, the British classification is followed, then the Lower Cretaceous contains no *Silicispongiae*. The question involved is one of stratigraphic correlation and subdivision and cannot be taken up in this paper.

¹O'Connell, M. 1917. The Ancient "Coastal Plain" of Central England. Paper presented before the N. Y. Acad. of Sci., May 21, 1917.

The first siliceous sponge fauna to appear in England came in with the assemblage of organisms the remains of which constitute the distinctive and long famous Warminster or *Pecten asper* fauna. In the environs of Warminster, Wiltshire, the beds of that name are about

Standard Classification		BRITISH LITHOLOGICAL AND STRATIGRAPHICAL SUBDIVISIONS		PALÆONTOLOGICAL ZONES	
Senonian	Mass-trichtian	Upper Chalk (with flints) maximum 1000' +	Chalk of Trimmingham	Zone of <i>Ostrea lunata</i>	
	Camp-anian		Chalk of Studland Bay and of Norwich	Zone of <i>Belemnitella mucronata</i>	
	Santonian		Chalk of Newhaven and Brighton	Zone of <i>Actinocamax quadratus</i>	
			Chalk of Cuckmere, Margate, Bridlington, Salisbury, Danes' Dike	Zone of <i>Marsupiles testudinarius</i> { Upper part with <i>Marsupiles</i> and <i>Actinocamax granulatus</i> Lower part with <i>Uvulacrinus</i> and <i>Actinocamax verus</i>	
Emsch-erian			Chalk of Broadstairs, Flamborough Head	Zone of <i>Micraster coranguinum</i>	
			Chalk of Dover	Zone of <i>Micraster cortestudinarium</i>	
Turonian		Middle Chalk (without flints) up to 240'	Rough nodular Chalk of Dover "Chalk Rock"	Zone of <i>Holaster planus</i>	
			Chalk without flints, Dover, Hesse, etc.	Zone of <i>Terebratulina lata</i> (= <i>gracilis</i>)	
			Hard nodular Chalk of Shakespeare's Cliff, etc. "Melbourn Rock"	Zone of <i>Rhynchonella cuvieri</i>	
Cenomanian		Lower Chalk 60' - 250'	Grey Chalk of Folkstone; Belemnite marl at top. "Totternhoe Stone"	Zone of <i>Holaster subglobosus</i> with subzone of <i>Actinocamax plenus</i> at top	
			Chalk marl "Chloritic marl," Glauconitic Marl and Cambridge Greensand Warminster beds	{ Zone of <i>Schloenbachia varians</i> with subzone of <i>Stauronema carteri</i> at the base Zone of <i>Pecten asper</i> and <i>Cardiaster fossarius</i>	

thirty-five feet thick and consist of greensands at the base and top with sands and interbedded cherts (Chert beds) in the middle, the latter being the horizon from which practically all of the siliceous sponges of Wiltshire have come. They were figured but not described by Miss Benett in 1831, and recently Hinde has redescribed and reidentified all of the specimens so that the fauna is now known to comprise twenty-three species (Jukes-Browne, 1900, pp. 247-248, 480, 481). Two of these also occur in the highest *Pecten asper* beds on the Isle of Wight, where one species (*Axinella stylus* Hinde) not recorded from Warminster has also been found, while the fauna also includes the three Upper Gault species already mentioned.

These twenty-four species then, constitute the total known siliceous sponge fauna in the Cretaceous rocks of England below the Chalk. I believe that all of these but the three from the zone of *Schloenbachia inflatus* belong to the Cenomanian, though I cannot discuss the point here. However, in giving the total number of species for the Upper Cretaceous of England, I shall include therein the Warminster fauna of the *Pecten asper* zone, since it would otherwise be difficult to compare with the figures for entire faunas on the Continent, where the rocks containing *P. asper* are always recognized as marking the base of the Cenomanian.

The total Chalk fauna of England includes 131 species of Silicispongiæ exclusive of those occurring in the *P. asper* zone or 155 species if they are included. In the following table the distribution in periods is shown.

<i>Period</i>	<i>Total number of species</i>
Senonian	83
Emscherian	47
Turonian	40
Cenomanian	45
(including zone of <i>P. asper</i>)	

Since the zone of *P. asper* has six species in common with the zone of *S. varians*, the number of separate species for the Cenomanian is $24 + 27 - 6 = 45$. This includes one species from the Lower Chalk of South England, the exact horizon not being known.

The zonal distribution of the Silicispongiæ is as follows, so far as may be judged by the data now at hand, but had Hinde completed his monograph on the British Cretaceous sponges the fauna would undoubtedly have been found to be much larger.

GEOLOGICAL PERIOD	PALÆONTOLOGICAL ZONE	NUMBER OF SPECIES
SENONIAN	Zone of <i>Ostrea lunata</i>	4
	" " <i>Belemnitella mucronata</i>	19
	" " <i>Actinocamax quadratus</i>	45
	" " <i>Marsupites</i>	36
EMMSCHERIAN	" " <i>Micraster coranguinum</i>	33
	" " <i>Micraster cortestudinarium</i>	40
TURONIAN	" " <i>Holaster planus</i>	39
	" " <i>Terebratulina lata</i>	27
	" " <i>Rhynchonella cuvieri</i>	16
CENOMANIAN	" " <i>Actinocamax plenus</i>	0
	" " <i>Holaster subglobosus</i>	0 or 7 ¹
	" " <i>Schloenbachia varians</i>	26 or 19
	" " <i>Pecten asper</i>	24

From the figures here presented it will be seen that, while there are fluctuations in the numbers of species in successive horizons, nevertheless, there is a fairly constant increase reaching the maximum in the zone of *Actinocamax quadratus*. This closely parallels the distribution in northwest Germany where, however, the fauna is very much larger and includes 197 species for the *A. quadratus* zone, as compared with 45 for the same zone in England. These faunal maxima are in decided contrast with the representation in Bohemia, where 82 species occur in the Cenomanian and the number steadily decreases until the fauna disappears entirely in Upper Emscher time.

In the Cenomanian of Great Britain there is no large siliceous sponge fauna except that of Warminster, already referred to. Species occur in no great abundance in the various subzones of the zone of *Schloenbachia varians* and at scattered localities, most of which are in south and southeast England, only three species being known from as far north as Hunstanton, Norfolk. With the exception of seven species from Dover, the horizon of which is in doubt but which is either that of the zone of *S. varians* or of *H. subglobosus*, there are no siliceous sponges found in the Cenomanian above the zone of *S. varians*.

¹ These six species were listed by Zuckers-Rosen as coming from either the zone of *H. subglobosus* or that of *S. varians*. It would more probably that they came from the latter.

The Turonian, while not showing a numerical increase in species, yet contains in reality much larger faunal groups than does the Cenomanian in which the species are of more or less sporadic occurrence. Thus thirty-five of the forty Turonian species occur in the Chalk at Dover or in the nearby cliffs along the Kentish coast. Practically all of the siliceous sponges of this period are found at localities south of the London basin, though a few species in the highest Turonian are found as far north as Bedfordshire.

There is a similar geographical aggregation of species in the Emscherian Chalk, for most of the sponges occur in sections along the Kentish or Sussex coast and only one species has been reported north of Bedfordshire. The Emscher species have, on the whole, a broader distribution in southern England, than do those of the preceding period; thus, many are noted from Wilts, and even from southern Dorset, and a few have been found in Hampshire and Surrey. A single species, *Camerospongia subrotunda* Mantell, occurs as far north as Norfolk, foreshadowing the wider range which is noticeable in the Senonian.

It is thus apparent that the siliceous sponges of the Cenomanian, Turonian, and Emscherian of England are confined to the southern and southeastern counties, the two most prolific areas being Wiltshire and the coast in the vicinity of Dover together with the Sussex region. But in the Senonian, where the largest and most diversified sponge faunas appear, the center of sponge population moved northward so that we find the best representation in Norfolk and Yorkshire, although some of the species are also found along the southern and eastern coasts. Thus, in the zone of *Actinocamax quadratus* twenty-nine of the forty-five known species come from Yorkshire, while nearly all the remaining species come from Sussex. The fauna as a whole loses its provincial character and becomes cosmopolitan being much the same as that which is so well developed in Germany. Above this zone the siliceous sponges rapidly disappear so that in the zone of *Belemnitella mucronata* there are only nineteen species recorded, these mainly from Norfolk, while in the highest Chalk in England which has been found only at Trimingham, Norfolk, there are only four species. These occur also in the Mæstrichtian of Rügen and Belgium and they thus serve to corroborate the evidence furnished by the rest of the interesting fauna of the Trimingham Chalk that there is at least a slight representation of the highest Senonian *sens. str.* in England.

The chief writers on the important areas in which siliceous sponges have been found in the British province are the following: Mantell

(1822) and Dixon (1850) for Sussex, Phillips (1829, 1835, 1875) and Lee (1839) for Yorkshire, Hinde (1880) for Norfolk, Benett (1831) for Wiltshire, and Tate (1865) for Ireland. The most important single work on the British sponges is the 'Catalogue of the Fossil Sponges, etc.' by Hinde (1883), which contains descriptions of all of the species in the British Museum. The same author began but did not complete a volume to be devoted to the Cretaceous species alone. In the three volumes by Jukes-Browne on the Cretaceous rocks of Great Britain complete faunal lists for each horizon in each county will be found and in the last volume a list for the entire British Cretaceous, but there are no descriptions of species (Jukes-Browne, 1900, 1903, 1904).

(2) Subprovinces on the Borders of the Central Plateau

To the south and southeast of the Welsh dome lie the London and Hampshire synclines with the Wealden anticlinal between them. During the Cretaceous these structural features did not exist, so that deposition took place throughout the area and the Chalk was continuous from the Isle of Wight to Hunstanton and from Dover and Yarmouth westward to, and perhaps over, Wales. The London and Hampshire synclines are now filled by the Tertiaries so that the Cretaceous rocks are known only from borings, while the Chalk has been stripped off from the Wealden anticlinal leaving only the Lower Cretaceous to view. South of the Hampshire syncline the Cretaceous beds are again brought to the surface in the sharp anticline which gives rise to the Isle of Wight, the southern portion of which is formed of Lower Cretaceous rocks, the northern of Tertiaries, while a narrow strip running east and west through the center of the island consists of the Chalk which is exposed on the steep northern limb of the anticline. The folds constituting the Weald anticlinal and the Isle of Wight anticline have been traced into northern France, where they assume an easterly southeasterly trend and finally die out beneath the Paris Basin. Thus one line of folding, the northernmost, strikes northwest from Arras, reaches the French coast between Calais and Boulogne, continues to the English coast, where it appears at Dungeness, whence it proceeds from east to west through the northern part of the Weald, in the direction of Frome and the Bristol channel. This is the axis of Artois, first recognized and named by D'Archiac in 1846. To the south of this Hébert has recognized a second line, the axis of La Bresle, which leaves France at Tréport and enters England between Hastings and Beachy Head, where it constitutes the Greenhurst anticline which is recognized to the west in the Vale of

Warminster. The axis of the Pays de Bray in the department of Seine-Inférieure, first described by Élie de Beaumont and later in great detail by De Lapparent, probably finds its continuation in England in the fold which runs through the Isle of Wight and into Purbeck. The Paris Basin is bounded on the north by the Artois axis, on the east by the Rhenish dome (Grabau), of Palæozoic, early Mesozoic, and crystalline rocks, which is breached by the Rhine graben, on the south by the Central Plateau and on the southwest by the eroded core of the Armorican mountain chain, the remnants of which form the hills of Brittany and are continued across the English Channel in folds of ancient rocks in Devon. Within this arc of ancient sedimentary and crystalline rocks lies the Paris Basin, the center of which is filled with the Tertiaries but the rim of which is composed of a number of escarpments formed by the edges of the Jurassic and Cretaceous rocks where these have been exposed by the circumferential stripping of the Tertiaries from the more elevated outer portion of the basin. Thus we may picture a basin filled with progressively smaller and smaller saucers, the basin being the structural depression in the embrace of the older rocks, the largest saucer being the layer of Triassic rocks, the next smaller the layer of the Jurassic, then the Cretaceous, and, finally, the saucer in the center being the Tertiaries. This mode of deposition over the entire basin and of subsequent erosion accounts for the occurrence of the Chalk in the Paris Basin as an arc, concave toward Paris and England and finding its continuation beyond the Boulonnais along the northern limb of the Wealden anticline. The Chalk has been eroded more or less along the French coast but is still preserved intact under the numerous scattered outcrops of the Eocene which have not yet been removed in the general stripping away of the Tertiary cover. In the central part of the Paris Basin the Chalk is known only from borings and in a few places where the rivers have cut down through the Oligocene and Eocene into the Mesozoic beds.

In France two main provinces are recognized for the Lower Cretaceous: (1) the Paris Basin, which is structurally, stratigraphically, and palæontologically united with south and southeast England, and the deposits and fauna of which belong primarily to the northern or boreal sea; and (2) southern France, in the Rhone region and the old province of Provence, the deposits and fauna of which belong, together with those of the Alps, to the southern or Tethys sea. In southwest France lies the Aquitanian basin, which formed a westward embayment from the southern sea and which during the Lower Cretaceous was separated from the

northern sea by the massif of the Central Plateau and the dry land areas of Normandy and Touraine. In the Upper Cretaceous the two provinces lose their distinctness; the boreal sea advances from the northeast upon the plateau of Normandy, while the southern sea advances northward through the straits of Poitou, so that the Aquitanian basin is joined to the Paris Basin, as is shown by the intermingling in Charente of the typical northern ammonites and pelecypods with the southern rudistes fauna which penetrated into northern France, into Belgium, and even over to England. This union of Tethys with the boreal sea was effected by the end of the Cenomanian, by which time most of southeast France had become dry land through the emersion of a ridge which joined the Central Plateau on the west. In the Aquitanian basin and in Normandy and Touraine the sediments of the Upper Cretaceous were of terrigenous origin, differing both from those in the Paris Basin where Chalk was accumulating and from those in the deeper waters of the Rhone basin where shell limestones were forming.

a.—*The Paris Basin*

The same vertical lithological succession obtains in the Cretaceous of northern France as in that of England, namely, greensands at the base followed either by marls and chalk or immediately by chalk. There is likewise the same chronologic variability in the series of the two regions, the age of the basal greensand beds ranging from the Aptian to the Senonian with a concomitant range from the Albian to the later Senonian for the base of the overlying chalk.

On the southeastern border of the Paris Basin in the Department of Aube there was continuous marine deposition throughout the Cretaceous, for this region was about in the center of the "straits of Morven," a narrow connecting water-way between the Paris Basin and the southern sea. The stratigraphic succession in Aube does not follow the usual rule of beginning with a sandstone facies but, instead, the earliest Lower Cretaceous (here the Hauterivian) is a limestone which rests directly on the eroded Jurassic surface and which contains many sponges, pelecypods, and corals. In this region the chalk deposition began very early, appearing even in Albian time and continuing throughout the Cenomanian, Turonian, and Senonian. Leymerie has described and figured three species of siliceous sponges from the Cretaceous of Aube (1842), but it is probable that the fauna is very much larger, considering the abundance of species in adjoining portions of the Paris Basin. The occurrence of siliceous sponges in the Hauterive of Aube

and in the Neocomian of Germiney in Haute-Saône is of interest as being the first appearance of these organisms in the northern basin of France.

In following the chalk escarpment northwest from Aube it is found to pass through the departments of Marne, Ardennes, Aisne, Nord, and Pas-de-Calais; north of Ardennes the outcrops continue into Belgium in Hainault and Brabant. Towards the Franco-Belgian border the successive divisions of the Cretaceous overlap each other and each in turn comes to rest on the old Jurassic surface. Thus, in the department of Marne, the Aptian is the first bed to be deposited on the Jurassic; in the Ardennes, the Albian; at Lille in Nord, the Upper Cenomanian; at Aachen, the Lower Senonian, the lower beds of which fill in the hollows eroded in the surface of the primaries. The stratigraphic overlap and the rise of the chalk facies in the series indicate that the sea spread northward and the detailed evidence shows clearly that there was a land axis bounding the Paris Basin on the north and serving as a source of supply for terrigenous material as well as a partial barrier between the German and French basins. This land ridge was not completely submerged until middle Senonian time and, even then, it was never far below the surface of the sea.

If we return to Aube and follow the escarpment to the south through Yonne, Nièvre, and Cher, an overlap similar to that north of Aube is observed. Thus, near Sancerre in Cher the Albian overlaps the Aptian and lies upon the Jurassic, while west of Bourges in the same department no Albian is found but, instead, the Cenomanian is the first Cretaceous to have been deposited. The escarpment turns northwest from Cher, passing through Indre-et-Loire, Loire-et-Cher, Sarthe, Mayenne, Orne, and Calvados. There is a greater or less development of the Cenomanian in all of these departments and, because of the proximity to the mountain mass of Bretagne at the time of deposition, the Cenomanian beds are all of clastic origin, being sands and greensands with some shales. The broad central part of the Paris Basin lying between this southwest rim, where siliceous deposits were accumulating, and the northeast rim, where the sea lapped against the projecting land axis of the Belgian border, was comparatively free in the later Cretaceous from the influence of terrigenous sediments and there was accumulated the pure chalk which is particularly well developed in the lower reaches of the Seine in the departments of Eure and Seine-Inférieure. Pure chalk, however, was not formed in this central area until late Senonian time for, during the Cenomanian and Turonian, while the rivers from the bounding land

masses were supplying large quantities of siliceous elastics, the sea was charged with sands and even coarser material but, as the lands were lowered and the sea spread over them, less detritus was supplied and organic accumulations became dominant so that during the Senonian chalk formed in the very regions where sands had been deposited during the Cenomanian and Turonian.

It was pointed out in the chapter devoted to a résumé of the literature on siliceous sponges that we have no modern treatise on the French faunas. Therefore, it is impossible to state how many species occur in the different formations and it is equally impossible to make faunal comparisons with other regions, especially England and Germany. Since the descriptions given by Fromentel, Courtiller, and other French writers were based on the external form of the sponges and not upon the type of spicule or the skeletal arrangement, it will undoubtedly be found, when the revision is made, that a large number of the old "species" are in reality but morphological variants of a single species, as indeed has been found to be the case whenever any of the French species have been redescribed. However, an approximate idea of the size and distribution of the sponge faunas of the Paris Basin may be gained from the work which has already been done and I shall summarize briefly what is known, although it must be remembered that the entire French sponge fauna of the Cretaceous must be revised and the terminology and descriptions be brought up to date.

From the Lower Neocomian of Haute-Saône and Yonne, Fromentel (1859) has described five species which probably occur in the Hauterivian; from the Aptian of Aube, the same author has described a single species.

D'Orbigny (1850) listed 205 species of sponges from the Cretaceous but, unfortunately, he did not state which occurred in France and which were known only from England or Germany.

Michelin in his '*Iconographie Zoophytologique*' (1840-47) described a large number of species from the Lower Cenomanian of various parts of France. Of all the early French works his is perhaps the most reliable, in spite of its unscientific phraseology, and his illustrations are so satisfactory that later authors have been able to accept many of his specific names in making their redescriptions. He makes no mention of skeletal elements or structures but otherwise his characterizations are at least no worse than those given by his contemporaries and in some cases they are better. His work is particularly helpful in including the distribution of the French species in other countries, mainly

England and Germany, and in containing the record of the occurrences of single species in various French localities.

From the *Craie Chloritée* (Cenomanian) of the departments of Calvados, Orne, Indre-et-Loire, Touraine, Loire-et-Cher, Seine-et-Oise, and Ardennes, Michelin has described fifty-one species (1840-47, pp. 120-147). From the *Grès vert inférieur* of Grandpré in the department of Ardennes and the *Tourtia de Cherk* near Tournai, Belgium, he has described a single species (p. 6). It is unfortunate that he spoke of all the species which he described as coming from the *Grès vert*, this lithological name being of no stratigraphic value, since the facies ranges, as we have seen, from the Aptian to the Senonian. Therefore, while it helps to some extent to know that a species comes from the greensand of a certain locality, the exact horizon cannot be ascertained because in a single place the section may begin with greensands which continue for some distance vertically, at least through two or more palæontological zones. Thus I can usually give only the approximate age of Michelin's various greensands. From the greensand in the environs of Mans, in Sarthe, eleven species are described by Michelin (p. 195).

From the Senonian Chalk of Saumur in Maine-et-Loire, Courtiller (1859) described 152 species and one variety, but that this fauna is by no means so large as the numbers seem to indicate may be judged from the fact that twelve of these "species" were included by Zittel under a single species of his own.

The most important contribution to the literature on the sponge faunas of any part of France is one made by Počta in which he described thirty-four species from the Senonian of Châteaux Meaulne, near Lude in the department of Maine-et-Loire (1892, list on p. 22). The specimens which he studied had been collected by Fräulein Boxberg and had been acquired by the Dresden Museum some twenty years before. H. B. Geinitz gave a preliminary notice of four species of the sponges which he had identified (1870, p. 149), but the full description of the fauna was not undertaken until 1892. This contribution is valuable for two reasons: first, because Počta employed the Zittel method of study and classification based on skeletal structure and arrangement and, second, because it was the first paper to be written on the large Paris Basin Cretaceous sponge fauna in which the species were designated according to modern terminology so that it is possible to institute comparisons with the faunas of nearby European regions. The description of this single fauna from the southwest portion of the Paris Basin enables us to gain a fair idea of the character of the fauna of the whole basin and

we find that the species all belong to the genera which were common in England and Germany and that nearly two-thirds of the assemblage is made up of the same species which occur in the Senonian of Germany.

The Cretaceous sponges of Seine-Inférieure have been in part described by Passy (1832), the distribution being as follows:

Upper Cretaceous—Dieppe, Rouen, Le Havre, etc. . . 11 species.

Lower Cretaceous—Rouen, Le Havre, etc. . . 4 species.

Lamouroux (1821, 1824) described from the Senonian Chalk of Caen in Calvados eleven species of sponges and from the "marne bleue" (Cenomanian?) two species.

Our knowledge of the fauna of the Chalk of the northeastern rim of the Paris Basin is derived largely from a short paper published by Barrois in 1898 in which he listed twenty-three species of sponges identified by him. He did not figure or describe any of the specimens nor did he note any new species. From the Cenomanian (Gaize & *Schloenbachia inflata*) in the environs of Vouziers and Rethel, department of Ardennes, he recorded six species; from the Marne de Givron with *Schloenbachia varians*, one species at Les Fondys; from the Tourtia with *Acanthoceras latidavus*, one species from Dorignies, near Douai, Blanc-Nez; from the marl with *Acanthoceras rhotomagense* of Blanc-Nez two species. From the Turonian Chalk with *Micraster breviporus* he listed three species and from the Senonian, zone of *Micraster cortestudinarium*, of Lezennes, ten species. All of these species occur either in Germany or in England or in both countries.

b.—The Aquitanian Basin

The basin of Aquitania derives its name from the old Roman province of Aquitania, which extended from the Pyrenees to a little south of the Loire and from the Bay of Biscay to the lands bordering the Gulf of Lyon. During the early Lower Cretaceous this basin was dry land and was drained by rivers flowing southward and southeastward into the Tethys sea. An embayment from the Tethys gradually spread over the lands now forming the hydrographic basin of the Garonne River and for a time this southern sea, including the bay of Aquitania, was wholly cut off from the boreal sea of the Paris Basin by the uplifting of an axis across southeast France, the axis forming a continuous land bridge from the Central Plateau massif to the uplands occupying the site of the present Alps. The only marine connection during Cenomanian time between the Paris Basin and the Aquitanian basin was by a narrow channel which passed through Poitiers in the province of

Poitou west of the Central Plateau. The channel widened during the Turonian and in the Senonian there was free passage between the Tethys and boreal seas so that when the land axis of the Franco-Belgian border was submerged, the waters of a single sea covered France, England, Germany, and Russia, as is proved by the identity of the fossils in the Chalk of these countries.

There can be hardly any doubt that there are large numbers of siliceous sponges in the Cretaceous rocks of Aquitania, for in Touraine and Anjou at Tours and Saumur the Senonian Chalk has yielded an extensive fauna as we have seen. Furthermore, scattered references in the literature show that species have been recorded from Île de Noirmoutier in the department of Vendée, south of the embouchure of the Loire, while it is known that sponges occur in the Lower Cretaceous to the south and therefore must have entered the Aquitanian basin as soon as that was filled by an arm of the Tethys. Thus, even though direct evidence of the presence of *Silicispongiæ* in this basin is lacking, we may yet feel sure that the organisms were there and that it is only a matter either of making collections or of describing collections which have been made and which may even now be in some museum awaiting attention.

c.—*The Rhone Valley and the Jura*

During the early Lower Cretaceous, the sea covering southeastern France and western Switzerland was entirely separated from the northern sea, for northern and central France were dry land. In this southern Mediterranean lived a fauna characterized by aberrant types of pelecypods, the rudistes, and by multitudes of distinctive ammonites. That siliceous sponges were abundant in the littoral facies in the province of Provence, in Dauphine, and in the Jura is known, but the fauna has for the most part never been described. Lorient described and figured a number of sponges from the Middle Neocomian of Mont Salève (1861-1863) and thirty species from the Lower Urgonian of Landern in the Canton of Neuchâtel, Switzerland (Lorient and Gillieron, 1869), but he used Fromentel's nomenclature and classification with the result that the work will at some time have to be done again. It is probable that these sponges which are found in the extreme southeast of France and also along the routes of marine communication with the Paris Basin during Lower Cretaceous time contributed no small part to the Upper Cretaceous fauna of the northern basin. However, until the French sponges have been monographed, faunal comparisons must be mainly conjectural.

In the Upper Cretaceous the Tethys lost its integrity so that northern species entered its waters and many of the southern forms migrated northward, though stenothermal species were abundant enough to constitute persistent northern and southern faunas, the elements of which can readily be distinguished. In the department of Alpes Maritimes in the Senonian Chalk of Nice, siliceous sponges are found which, though belonging in part to species unknown in the northern fauna yet include some of the same forms which are abundant in England and Germany, while all of the genera are the same as those found in north-west Germany. The siliceous sponges of Nice were described by Počta according to modern methods, so that we are provided with some reliable information about the character of the southern fauna in the Upper Cretaceous and may predict that when the sponges of the Chalk of the Paris Basin receive a similar treatment the species will be found to be identical with, or closely related to, those of the Chalk of England and Germany, as has proved to be the case with the thirty-four species described by Počta from Meaulne (see above, p. 65) and with the twenty-three listed by Barrois (1898). According to Počta (1907), the sponges at Nice are excellently preserved so far as internal structure is concerned but the delicate surface structure has in many cases been effaced because the sponges were much rolled and worn before their final entombment. Thus, there are actually many more species than Počta has been able to name but, because of the fragmentary condition, further identifications are impossible. His list follows (Počta, 1907):

Doryderma ramosum (Mantell)
Scytalia laghetensis Počta
Verruculina cazioti Počta
Verruculina species
Chonella andreensis Počta
Siphonia ficus (Goldfuss)
Cymmatina inflata Michelin
Thamnospongia pauciramea Počta
Pachycorynia erecta Počta
Ragadinia species

From the *Grès vert inférieur* of Uchaux in the department of Vaucluse on the east side of the Rhone, Michelin described five species which are Turonian (?) in age.

(3) Subprovinces on the Borders of the Rhenish Dome

There are four important subprovinces on the northwestern, northern, and southeastern borders of this dome. These are, from west to east: (a) the Maastricht-Aachen district on the German-Belgian border, (b) the Westphalian district between the Rhine and the Plain of the Ems, (c) the plains of Hanover and the northern border of the Harz, and (d) the Bavarian region near Regensburg (see map).

a.—*The Maastricht-Aachen District*

This small area is made up of Senonian beds which are nearly horizontal or but slightly inclined and which lie unconformably upon the strongly folded and faulted Carbonic and older beds. They show the following succession in descending order:

UPPER SENONIAN.—Mucronatenkreide with *Belemnitella mucronata*

4.—Maastricht beds. Tuffkreide, many bryozoa, echinoids, baculites, gryphæas, terebratulas, and foraminifera. Sponges occur particularly at Petersberg near Maastricht. (20 m.).

3.—Chalk marl with flints in the upper part, *Gryphæa vesicularis*, *Nautilus*, etc.

LOWER SENONIAN.—Quadratenkreide with *Actinocamax quadratus*

2.—Greensand with many fossils including *Baculites incurvatus*; conglomerate at the base.

1.—Aachen sand. Chiefly an old beach and dune sand with numerous plants, especially silicified woods, and with *Exogyra*, *Inoceramus*, *Actæonella purgulifera*, etc., up to 100 m. or more in thickness.

The Mucronatenkreide here locally transgresses over the Quadratenkreide, while each zone of the Senonian, according to Holzapfel, begins with a basal conglomerate, indicating repeated transgressions and regressions of the sea and, on the whole, shallow water conditions. The composition of the successive faunas suggests a littoral habitat where, however, the waters were not charged to any great extent with terrigenous material. The sponges from this section are found mostly in the Maastricht beds, and have been described by Schlotheim (1820), Roemer (1841 and 1864), and Dewalque (1880), and listed by Murlon (1881, pp. 127, 128).

b.—*The Westphalian District*

This area lies east of the Rhine and north of the old folded series of the Schiefergebirge, and is known as the Westphalian or Münster basin. On the east and northeast it is bounded by the Teutoburger Wald, which is a Post-Cretaceous uplift separating this basin from the adjoining

Hanover basin. This uplift has brought the Jura, Trias, and older beds to the surface in a series of northwest-trending hills, the beds dipping away steeply on either side of the uplift, to the west in Westphalia, to the east in Hanover. It is in this area that the oldest Cretaceous beds occur. The Lower Cretaceous is found upon the borders of the basin, a boring near Bentheim showing over 844 meters, but the beds thin away toward the south and west where they are overlapped by the Cenomanian and higher formations. The base of the Cretaceous series consists of the Teutoburger sandstone, a white, heavy-bedded, quartz sandstone which in a few localities has furnished fossils indicative of Neocomian age, though for the most part it is unfossiliferous and undoubtedly is of continental origin. This is succeeded by sands and clays representing the Gault and by Pläner beds of the higher series. Along the southern border of the basin the series begins with the Cenomanian Essener greensand, which is represented in the Teutoburger Wald by the Flammenmergel. Following upon the Essener greensand, are the Turonian Pläner with intercalated greensands, the Emscher marls, and the Senonian sand marls and sandstones, the higher beds occurring toward the center of the basin. We may look at these Upper Cretaceous formations in more detail.

Turonian.—This is found mainly toward the center of the basin and consists of brightly colored pläner. Schlüter and Johann Böhm have recognized the following zones in descending order:

- 4.—Zone of *Inoceramus schloenbachi* and *Epiaster brevis* (Schloenbachi Pläner).
- 3.—Zone of *Heteroceras reussianum* {
 - (c) Greensand with *Micraster corlestudinarium*.
 - (b) Greensand of Soest with *Neoptychites peramplus*.
 - (a) Kalkmergel with *Micraster breviporus*.
- 2.—Zone of *Voliceramus lamarcki* and *Prionotropis woolgari* (Lamarcki Pläner).
- 1.—Zone of *Inoceramus labiatus* and *Mammiles nodosoides* (Labiatus Pläner).

Emscher.—Along the southern border of the basin is the Emsche River, a small tributary of the Rhine lying between the Ruhr and the Lippe. The section along the river is the type locality for the Emscher marls, which consist of bluish green, lime and clay marls, with some greensands, and which have a thickness of 300 meters. These marls form the transition series to the Senonian, with which they were formerly included and from which they were separated as a distinct formation by Schlüter. The Emscher rests directly upon the Cuvieri Pläner and is limited above by the Recklinghäuser sand marls. From the present

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the latter of *Actinocamax westfalicus* Schlüter, the entire series has been called the Westfalicus Kreide (see table, p. 50). G. Müller recognized the following faunal zones in descending order¹:

- Zone of *Inoceramus haenleini* and *Ammonites hernensis*.
- Zone of *Inoceramus digitatus*, *I. subcardissoides*, *Ammonites texanus*, etc.
- Zone of *Inoceramus involutus*, *I. exogyroides*, etc.
- Zone of *Inoceramus koeneni*, *I. kleini*, etc. and *Ammonites subtricarinatus*.

Senonian.—This division, about 350 meters thick, begins north of the River at Recklinghausen with 50 meters of yellowish marls and is followed by light colored sandstones and sandy limestones often rich in fossils. In some places gigantic ammonites, up to 2½ meters in diameter, are found. The higher parts of the series comprise the thin limestones of Sendenhorst and Billerbeck, which contain numerous fishes as well as fish, crustacea, and belemnites.

Generally the subdivision of the Senonian has been into a lower with *Actinocamax quadratus* (Quadratenkreide) and an upper with *Belemnitella mucronata* (Mucronatenkreide). Schlüter, however, restricts the Lower Senonian to the lower half of the Quadratenkreide and unites the upper half with the Mucronatenkreide into the *Cæloptychium* beds, because of the presence of the sponge *Cæloptychium*, which is restricted to this horizon (see below, p. 74).

The chief work on the Cretaceous sponges of Westphalia has been by F. Roemer (1854), and C. Schlüter (1868, 1870, 1872, 1874, 1876b, 1876c, 1895); short papers by Ewald (1873). There are sponges from Westphalia in the Schrammen Collection.

3.—The Plains of Hanover and the Northern Border of the Harz

This area is separated from the preceding by the Teutoburger Wald (See map.) In it are most of the localities from which the sponges of the Schrammen Collection came, such as Oberg, Misburg, Ronnenberg, Salder, Nettingen, *et al.* (See below, p. 75.) It is undoubtedly the richest collecting ground in northern Europe for Cretaceous Silicispongiae. Along the southwestern border the beds are disturbed so they dip east (see sections, Figs. 1 and 2), while faulting in places has even cut out certain members altogether. This series may be con-

¹Müller, G., 1900, Zeit. d. d. geol. gesell. Protcol., p. 39.

sidered as a northern extension of the Cretaceous beds of Helgoland, near which island the Lower Cretaceous beds rest disconformably upon Middle Muschelkalk (Walther, 1910, p. 189).

In northern Hanover are certain scattered outcrops of the Cretaceous projecting through the drift. Three such outliers may be seen in the area around Lüneburg, about 45 km. southeast of Hamburg. There, in a quarry at Judenkirchhof, the Turonian is exposed; in Pieper's quarry, west of Lüneburg, the Cenomanian and Turonian may be seen;

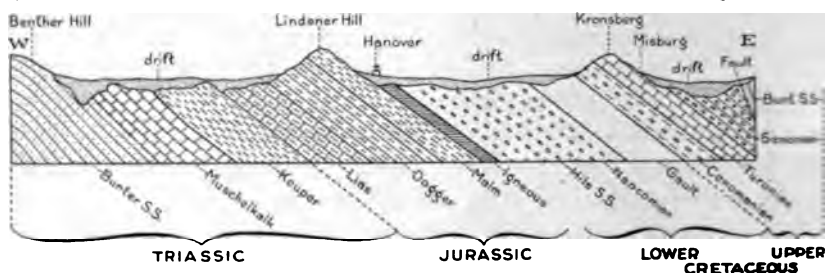


Fig. 1. Cross Section of the Country around Hanover, Germany, showing the stratigraphic relation of the formations in which sponges are found. (After Credner)

while at Zeltberg, north of Lüneburg, the Cenomanian, Turonian, and Senonian are all present. The first stratigraphic work to be done on the Cretaceous of Zeltberg was that by Strombeck (1863), but he overlooked many of the zonal subdivisions, because at that time quarry operations had not brought a sufficiently large number of sections to view and because stratigraphic work in general in northwest Germany was not so detailed as it is now. Since then the chief workers on the region have been Wollemaun (1902a), Müller, and Stolley. The following zonal classification of the Cretaceous of Lüneburg is recognized by Wollemaun (1902a, p. 6):

SENON (*sens. lat.*)

Mucronaten-Senon.	Trigonosema-Schichten.
Mucronaten-Senon.	Heteroceras-Schichten.
Mucronaten-Senon.	Unterste Schichten.
Quadraten-Senon.	
Granulaten-Senon.	
Emscher.	

TURON

Cuvieri-Pläner.
Scaphiten-Pläner.
Brongniarti-Pläner.
Labiatus-Pläner (Mytiloides-Pläner).

CENOMAN

Rhotomagense-Pläner.

Varians-Pläner.

Tourtia.

In the Osnabrück region, Lower Cretaceous of the Wealden type rests unconformably upon folded and eroded Lias and older beds and is succeeded by marine Upper Cretaceous, the character of which, on the whole, is much like that of the Westphalian basin. Here, as there, it is noteworthy that Turonian Pläner is succeeded by Emscher marls and Senonian sands, the series thus marking a decreasing depth of the Cretaceous sea from the Turonian onward.

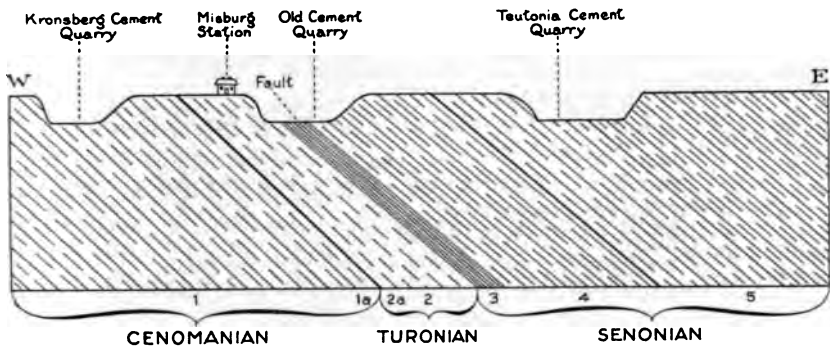


Fig. 2. Detailed Cross Section of the Upper Cretaceous at Misburg, Hanover, Germany. (After Schrammen, 1899.)

1. Limestone marls or Pläner with *Schloenbachia varians* Sowerby, *S. coupis* Brongniart and *Acanthoceras mantelli* Varians Pläner.
- 1a. Position of zone of *Acanthoceras rhotomagense*—not recognised here.
- 2a. Position of zone of *Inoceramus mytiloides* (*I. labiatus*)—Mytiloides or Labiatus Pläner—not recognised here.
2. Limestones with *Inoceramus brongniarti* Sowerby, generally poor in fossils. Between beds 2 and 3, fault cuts out Scaphites Pläner, Cuvieri Pläner and Emscher.
3. Clay bed (2-3 m. thick) with *Actinocamax granulatus* Blainville emend. Schlüter, *A. verus* Miller, and *Marrupites* Granulatenkreide.
4. Limestone marls (Pläner) with *Actinocamax quadrata* Blainville, *Micraster gibbus* Desor, *M. göttchii* Stolley, *M. haasi* Stolley, *Offaster pilula* Lamark, *Echinocoris vulgaris* Bleyn. and many sponges. Quadratenkreide.
5. Limestone marls (Pläner) with *Belemnitella mucronata* Schlotheim, *Epiaster gibbus* Schlüter, *Offaster corculum* Goldfuss, *Echinocoris vulgaris* Bleyn. and many sponges. Mucronatenkreide.

The strong disturbances which raised the Harz, in line with the Teutoburger Wald uplift, caused the beds of the north border of the Harz at Goslar and Harzburg to be overturned and the Jurassic and Triassic often to be faulted out. The Cretaceous of this section north of the Harz consists largely of marls, such as the famous sponge marls of Quedlinburg, of Lower Senonian age, from which many of Goldfuss' and Giebel's sponge types were obtained (see Goldfuss 1826 and 1862; Giebel 1849, 1851), and of sands like those of Goslar and Sudmerberg, of Gault (Albian) age, from which were collected many of the types described

by Roemer (1841, 1864a, and 1864b), and Schrammen (1910-12). The Cretaceous is followed unconformably by the brown-coal-bearing Oligocene beds. Strombeck has done the chief part of the stratigraphic work in this region near the Harz (see also Beyrich, 1849, 1851) and the subdivisions which he recognized over half a century ago are still accepted without much change; they are as follows in descending order (Strombeck, 1857, pp. 785-787; see also 1859):

B.—UPPER PLÄNER (Turonian)

8.—Cuvieri beds.

7.—Scaphites beds.

Lithologically the same as 6a.

6a.——Synchronous deposits—— 6b.

White Brongniarti beds.

Galerites beds.

(Gray and snow-white limestone.)

5.—Red Brongniarti beds.

Red marly limestone, fairly compact, in part showing conchoidal fracture.

Sharp break. Disconformity. Few or no species pass upwards.

A.—LOWER PLÄNER (Cenomanian)

4.—Beds poor in Rhotomagense.

3.—Rhotomagense beds with *Acanthoceras rhotomagense*.

2.—Varians beds, gray limestone with *Schloenbachia varians*, etc.

1.—Tourtia, green clay, sand, and clayey marl.

The plains of Hanover and the Westphalian basin are often classed together as the Cretaceous area of northwest Germany. It is with the sponge faunas of this region especially that Schrammen deals in his Monograph. Schlüter, whose studies were carried on primarily in Westphalia and whose stratigraphic work has been approached in large measure from the palæontologic side with little or no attempt at lithogenetic interpretations, has established the following zonal subdivisions for northwest Germany (1876b, see also other references in bibliography):

UPPER SENONIAN (*Cæloptychium* beds)

3.—Zone of *Heteroceras* (*Bostrychoceras*) *polyplocum* and *Scaphites pulcherrimus*. Soft, yellow sandstones and marls of Haldem and Lemförde in Westphalia, Ahlten near Hanover, etc.

Obere Mucronatenkreide.

2.—Zone of *Hoplites coesfeldensis* and *vari*, *Micraster glyphus*, *Lepidospongia rugosa*, etc. Here belong the marl, limestone and marl sandstone of Coesfeld, Darup, Rorup, etc.

Untere Mucronatenkreide.

1.—Zone of *Becksia soekelandi*. Contains also *Pachydiscus stoberi*, *Desmocerases obscurum*, etc. Obere Quadratenkreide

LOWER SENONIAN

- 3.—Zone of *Scaphites binodosus* and *Exogyra laciniata*. Here belongs the sandy limestone of Dülmen. Other fossils: *Pachydiscus duelmensis*, *Inoceramus lobatus*, and *balticus* (= *crispi* auct.).

Untere Quadratenkreide.

- 2.—Zone of *Pecten muricatus*, *Inoceramus lobatus*, etc., sandstone of Haltern.

- 1.—Zone of *Marsupites testudinarius*. Here belongs especially the Recklinghäuser sandmarl of Westphalia.

EMSCHER

Zone of *Ammonites margæ* and *Inoceramus digitatus*

TURONIAN (Oberer Pläner)

Zone of *Inoceramus cuvieri* and *Epiaster brevis* Cuvieri Pläner.

Zone of *Heteroceras reussianum* and *Spondylus spinosus* . . . Scaphites Pläner.

Zone of *Inoceramus brongniarti* and *Prionotropis woolgari*.

Brongniarti Pläner.

Zone of *Inoceramus labiatus* and *Mammiles nodosoides*.

Mytiloides Pläner.

Zone of *Actinocamax plenus*.

CENOMANIAN (UNTERER PLÄNER)

Zone of *Acanthoceras rhotomagense* and *Holaster subglobosus*.

Rhotomagense Pläner.

Zone of *Schloenbachia varians* and *Hemiaster griepenkerli* . . . Varians Pläner.

Zone of *Pecten asper* and *Calopygus carinatus* Tourtia.

The major part of the Schrammen Collection comes from Hanover, from an area not more than fifteen kilometers in radius. The localities from which the types have come are as follows:

LOCALITY	HORIZON	NO. OF SPECIES	NO. OF TYPE SPECIES	NO. OF SPECIMENS ¹
Ahlten	Mucronatenkreide	4	4	6
Haldem	Mucronatenkreide	1	1	2
Misburg	Mucronatenkreide	87	85	177
Misburg	Quadratenkreide	50	49	60
Oberg	Quadratenkreide	135	130	359
Sudmerberg	Emscher Marl	18	18	21
Grosse Heere	Cuvieri Pläner	23	20	50
Salder	Cuvieri Pläner	2	2	6
Nettlingen	Scaphites Pläner	32	29	46
		352	338	727

¹The total of 727 specimens includes all of the specimens from the 1914 Schrammen Collection from the localities listed, but does not include specimens from the 1903 collection except in two or three instances which are noted in the text in Chapter IV.

The Cretaceous sponges of Hanover and of the northern border of the Harz have been described by: A. Roemer (1841, 1864a, 1864b), Quenstedt (1876-1878), Zittel (1876, etc.; see bibliography). The most complete and detailed work for this area has been done by Schrammen (1899, 1901, 1902, 1903a, 1903b) and special mention is to be made of his monograph entitled 'Die Kieselpongien der oberen Kreide von Nordwestdeutschland' (1910-1912).

For the duchy of Braunschweig one must turn to the works of Griepenkerl (1888-1890) and especially of Wollemann (1901, 1902a, 1902b, 1902c).

d.—*The Regensburg-Passau Area*

This comprises a small outcrop in the neighborhood of the junction of the River Naab with the Danube along the borders of the Bohemian forest. Remnants of a formerly more extensive deposit of Cretaceous strata, once undoubtedly continuous with those of Bohemia, here rest upon the eroded and more or less dissolved surface of the Upper Jurassic. The series begins with Cenomanian greensands, though somewhat older iron-bearing beds, representing probably old surface soils, are found near Amberg. The Turonian consists of sands and marls with *Inoceramus labiatus* and, in the higher beds, *Scaphites geinitzi* and *Spondylus spinosus*. The Emscher has not been differentiated. The Senonian consists of gray marls with *Baculites anceps* and of coarse sandstones with *Exogyra laciniata* (Gümbel, 1894, 'Geologie von Bayern,' II, p. 834). The strata are mostly horizontal and their continuation lies below the Tertiary and alluvial deposits of the Danube plain.

(4) The Bohemian Basin, and Adjoining Districts of Saxony (Valley of the Elbe-Elbthal) and of Silesia

The Cretaceous deposits of Bohemia are found only in the northern and northeastern area of the basin. On the northwest the Erzgebirge and its southwestward continuation, the Elster and Fichtelgebirge, all composed of Palæozoic and older rocks, separate the Cretaceous rocks of Bohemia from those of the kingdom of Saxony and from the Mesozoic area of northwest Germany. (See map.) The ridge of old mountain chains is separated by the valley of the Elbe from the Lausitz granite mass which forms a part of the northern rim of the basin. The Cretaceous deposits extend down the Elbe valley, forming the picturesque sandstone cliffs of the so-called Böhmisches-Sächsisches Schweiz, a region familiar to all who have travelled from Dresden to Prague by boat or train and one frequently illustrated and described in German

texts. The deposits here exposed find their northernmost outliers for this region in the vicinity of Dresden and of the river gorge known as the Plauenscher Grund, famous for its remarkable fossiliferous basal conglomerates of the Cretaceous.

A second breach in the old rim of the Bohemian basin is formed by the Neisse river from Zittau northward. This depression separates the Lausitz granite mass from a similar granitic and folded Palæozoic complex which constitutes the Riesengebirge, a line of mountains trending southeastward and, with its two arms, the Erlitz and Adlergebirge and the Sudetic mountains, separating the Bohemian basin from Silesia (Schlesien) on the northeast.

North of the Riesengebirge, between the valleys of the Bobir and the Ketzbach, is a much disturbed area of Mesozoic rocks which form an embayment eastward from the Neisse depression in the old Palæozoic complex. This is the Löwenberg embayment, which, like that of the Elbe depression, marks a northward extension of the Cretaceous deposits into Lower Silesia (Niederschlesien). The connection of the Cretaceous of this embayment with the Bohemian Cretaceous is, however, concealed by the Tertiary and later deposits of the Neisse depression.

Between the two arms of the Riesengebirge, the southwestern or Erlitzgebirge and the eastern or Sudetic Mountains (Die Sudeten, partly in Austrian Silesia), lies the basin of Glatz, which contains Cretaceous strata now completely separated from those of Bohemia by older rocks but undoubtedly formerly continuous with it. Northeast of this highland of folded older rocks lies the flat Silesian region of Germany which is traversed by the Oder River, the course of which is nearly parallel to the old-land mountain mass of the Bohemian border. This flat land is covered by Tertiary and younger deposits, but from the midst of these at Oppeln on the Oder, rise isolated Cretaceous outcrops which have long been famous for their wonderfully preserved sponge remains, fifteen species of which are represented in the Schrammen Collection. Southeastward from the Oppeln region is the great upper Silesian Trias plateau, where deposits of this age more than 2000 meters in thickness overlie the folded and eroded Carbonic and Permian beds. The Silesian deposits of Oppeln will be described in a separate section, but those of Saxony (Elbthal) and of Löwenberg and Glatz will be considered with the Bohemian deposits of which they are an integral part. The following table (p. 78) shows the subdivisions of the Cretaceous deposits of all of these areas except Oppeln, and their correlation according to the recent interpretations of Scupin (1907, p. 714):

SCUPIN'S CORRELATION TABLE OF THE UPPER CRETACEOUS OF SAXONY,
SILESIA AND BOHEMIA

SUCCESSION IN NORTH- WESTERN GERMANY	UPPER CRETACEOUS OF THE LÖWENBERG REGION IN LOWER SILESIA	UPPER CRETACEOUS OF SAXONY	UPPER CRETACEOUS OF BOHEMIA	UPPER CRETACEOUS OF GLATZ
Lower Senonian <i>s. str.</i>	Silesian Super Quader (Überquader)			
Emscherian	Silesian Upper Quader (Oberquader)		Chlomek Beds <i>s. str.</i> Kreibitz Beds (= Lower Chlomek Beds)	Heuscheu Quader { Conglomerate of Hirtenstein Kieslingswald Sandstone
Unieri-zone	Neu-Warthau Beds			
	Ludwigsdorf Sandstone	Saxon Superquader (Über- quader)	Prissen Beds	Clay and Pläner of Kieslingswald Karlsberg Clay
Scaphites-zone	Gross-Rackwitz Scaphites Marl	Scaphites Marl of Zatschke		
			Teplitz Beds	
Brongniart-zone	Löwenberg Marl-sandstone	{ Strehlen Pläner Brongniart Quader and Pläner of the Saxon geologists	{ Iser Beds Malnitz Beds	Quader of the Wunsche- burger Lehma and west of Habelschwerdt
Labiatus-zone	{ Rabendock- stone, at base con- tains <i>Inoceramus labiatus</i>	Labiatus Quader and Pläner	Weissenberg Beds	Pläner Limestone
Zone of <i>Actinocamax plenius</i>	Pläner and Pläner Sand- stone of the <i>Plenus</i> - zone	<i>Carinatus</i> Pläner and Pläner Sandstone	Pläner, Pläner Sandstone and Glauconite Sand- stone of the <i>Plenus</i> - zone	Pläner Sandstone and Transi- tion Quader
Lower Cenomanian	Lower Quader (Unter- quader)	<i>Carinatus</i> Quader (Crednerian Division)	Korytan Beds Perutz Beds	Quader of Allendorf and Habelschwerdt

a.—*The Bohemian-Saxon Cretaceous Deposits and Those of the Löwenberg and Glatz Basins*

Beginning in the Dresden region, and continuing along the banks of the Elbe southward into Bohemia, there is found a wonderful succession of exposures of the Upper Cretaceous rocks. The Lower Cretaceous and older Mesozoic beds are everywhere absent in this district, the series beginning with beds of Cenomanian age. In many places a non-marine, river and pond deposit, with impure coal and leaf beds, forms the basal portion of the series, occupying the local depressions in the igneous or Palæozoic old-land surface. These are the *Credneria* beds of Saxon geologists and are characterized by several species of *Credneria*, together with ferns and other plant remains. The equivalent plant beds of Bohemia are called the *Perutz* (or *Peruc*) *formation* (Frič, 1869, pp. 46, 186; Frič and Bayer, 1901). This consists generally of a basal sandstone, followed by carbonaceous shales. The sandstone in places becomes of considerable thickness, replacing the shales, and is locally iron-bearing. Throughout, the series is devoid of marine fossils and contains conifers, ferns, and unios.

These non-marine beds were submerged by the transgressing Cenomanian sea which entered the region from the north and filled the old basins of continental deposition, overflowing their rims and eventually spreading out as a broad epeiric water body. This expansion of the sea accounts for the fact that around the margins of the old basins the marine deposits of the succeeding series overlap the preceding continental beds, resting in many places directly upon the crystallines or upon the folded and eroded Palæozoics, as first noted by Reuss (1845-46, p. 15). The contact with these older rocks is often a remarkable one as seen in the vicinity of Dresden (Plauenscher Grund) where a basal bed of large well-rounded boulders and cross-bedded sands lies in depressions of the older rock. These deposits were undoubtedly of continental origin, formed during the preceding period, and they were so little disturbed by the waves of the advancing sea that brachiopods, molluscs, and even entire sponge skeletons occur in a perfect state of preservation among these boulders. In some cases, deep, pot-hole-like excavations extend into the older rocks for ten, twenty or more feet and are filled with boulders, sand, and calcareous material abounding in beautifully preserved sponge and molluscan remains.¹ A section of such a deposit at Kahlebusch, near Dresden, kindly furnished to the author by Professor Grabau, is shown herewith (Fig. 3).

¹Grabau, A. W. 1913. *Principles of Stratigraphy*, p. 651.

Bohemian geologists call these lower marine beds the *Koritzan* (or *Korycan*) formation; while by Saxon geologists they are known as the *Carinatenquader* from the presence in them of *Ostrea carinata*, the zone fossil. (The term *quader*, first used in the literature, I believe, by Reuss in 1845-1846, or perhaps in his 1844 paper which I have not seen, is applied to any heavy-bedded sandstone which can be quarried in large blocks or "quader.") The series is also known as the Lower Quader (*Unterquader* of Reuss), which term is especially applied in the basins of Löwenberg and Glatz. The formation is frequently glauconitic and

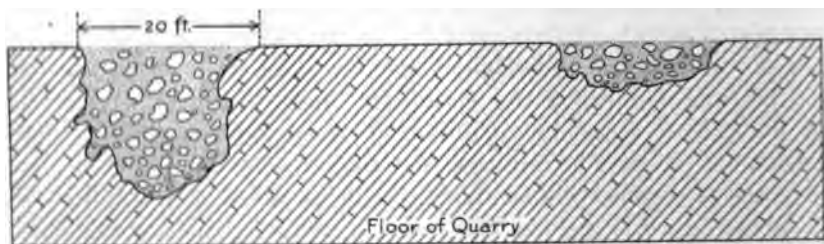


Fig. 3. Section in Quarry at Kahlebusch, near Dresden, Saxony, showing Nature of Contact between the Cretaceous and the Crystallines.

The rock is a basic porphyry with columnar structure, the columns inclined as indicated. The cavities are filled with worn boulders of the porphyry up to a foot in diameter and with sand and organic detritus in which fossils of Cenomanian age, especially sponges, abound. The form of the cavities is determined by the columnar structure, but the walls are worn smooth, and on these, in places, Cenomanian oysters grew. (From a sketch made by Professor A. W. Grabau in 1910.)

sometimes conglomeratic, and, in northern Bohemia, contains few fossils except the molds of large, thick-shelled, shallow-water Mollusca (e. g., *Trigonia*, *Cardium*, *Turritella* and *Rostellaria*). There is a remarkable difference in the fauna, however, in the southern part of the Cretaceous area, in the region between the Elbe and the Moldau, where calcareous beds with the aberrant molluscs of the order Rudistes (*Radiolites saxonicus*) follow upon conglomerates of local origin. These Rudistes beds contain the southern Cretaceous fauna and indicate a temporary connection between, or close approach of, the two great areas of deposition of the Cretaceous formations of Europe.

In northern and eastern Bohemia and in the Glatz basin the Koritzan series is entirely sandy but in Saxony it becomes calcareous and passes upward into the *Carinatus Pläner* and *Pläner sandstone*. (The name *pläner* is applied to any thin-bedded limestone, while *plänersandstein*, as a lithological term, is any sandy formation similarly separating into thin layers and indicating a more offshore deposit. There are

no equivalent lithological terms in English, for which reason the German names will be used.) The Pläner sandstone formation is characterized by the zone fossil *Actinocamax plenus*, a belemnite, and hence the zone is commonly designated the *Plenus* zone. It is especially well developed in the southern Silesian basin (Löwenberg) and in Saxony, where it is called the Lower Pläner (*Unter Pläner*). With it the Cenomanian division is brought to a close.

The Turonian begins in the south and east with the Middle Quader, a heavy-bedded quartz sandstone, and in the north with pläner limestones. These constitute the Weissenberg formation of Bohemia, and the Labiatus Quader and Pläner of Saxony, so named from the zone fossil *Inoceramus labiatus*. This species is characteristic of the Benton formation of the American Cretacic, with which this horizon is correlated. The Weissenberg beds include calcareous and marly sands and marls, generally richly fossiliferous with gigantic individuals of *Inoceramus labiatus* predominating. Besides these, occurs *Prionotropis woolgari*, another form characteristic of the American Benton formation. Towards the north and east these beds become more sandy, especially in the Löwenberg embayment. In the Glatz basin both Quader sandstone and Pläner occur.

The next higher division of the Turonian is characterized by *Inoceramus brongniarti* and is known as the Brongniarti Pläner and sands. In Bohemia the series constitutes the Malnitz beds, calcareo-arenaceous, thin-bedded strata, rich in glauconite grains, for which reason Reuss called this formation in the northwestern and northern region the Greensand. The most common fossil is *Lucina lenticularis* Goldfuss, which occurs in great abundance. Eastward this series merges into sandstones of the Iser type (see below).

In the western part of the Bohemian basin the Teplitz beds succeed the Malnitz greensands. These consist of pläner limestone and marl containing molluscan remains, among which *Ostrea sulcata* should be noted. The presence of *Scaphites geinitzi* and *Spondylus spinosus* in beds of this series indicates their correlation with a part of the Scaphites zone of northwestern Germany.

The Iser sandstone replaces more or less completely both Malnitz and Teplitz' beds towards the east and northeast. It consists of a great series of frequently arkosic sandstones, ranging in thickness up to 122 meters or over, and is displayed in a remarkable succession of erosion pillars and pinnacled hills along the Elbe River on the Bohemian-Saxon

border. From the similarity of the striking scenery, produced by the erosion of this sandstone, to the scenery of Switzerland, this region has received the name of the Böhmisches-Sächsisches Schweiz. Between the town of Milnik in Bohemia and the Riesengebirge, these sandstones form a great series of high plateaus rising above the Iser River, from which the formation takes its name. Fossils occur in certain zones and localities, those most characteristic being *Exogyra columba* and *Spongites saxonicus* (now considered to be inorganic) while beds largely composed of *Rhynchonella bohémica* and *Ostrea vesicularis* are also present. Westward this formation wedges out between the calcareous Malnitz and Teplitz beds, which there replace it. This points to an eastern, or rather northeastern, origin of the sands which composed the Iser formation.

A part of the succeeding Priesen beds of the Bohemian region is still included in the Scaphites-zone, while the remainder belongs to the Cuvieri-zone. In Saxony the marls of Zatzschke, with *Scaphites geinitzi*, separate the Upper Quader (Oberquader) from the Super Quader (Ueberquader), the latter being correlated by Scupin (1907, p. 714) with the upper part of the Priesen beds of Bohemia and the Cuvieri-zone of northwestern Germany (zone with *Inoceramus cuvieri*). In Bohemia the Priesen beds consist largely of clays which abound in *Baculites faujasi* (a Senonian form) and *B. anceps*, from the presence of which they are known as the Baculite marl (Bakulitenmergel). In the lower part of the formation *Scaphites geinitzi* still occurs.

This brings us to the top of the Turonian, which is the top of the section in Saxony. Two higher formations occur in northern Bohemia and are likewise represented in the Glatz and Löwenberg regions. In Bohemia they are known as the Krebitz and Chlomek formations, respectively, and consist for the most part of sandstones with some marls, characterized by *Baculites incurvatus*, *Exogyra laciniata*, and other Mollusca. In the Glatz basin they are represented by Quader sandstone and conglomerates, and in the Löwenberg embayment by the Neu-Warthau beds and the Silesian Oberquader which, as will be seen by consulting the correlation table, is not only higher than the Ober Quader of Saxony but is actually above the Super Quader of that section, which still belongs in the Turonian, while the Silesian Oberquader is Upper Emscher (Scupin, 1907, 1912-1913). In Silesia, too, occurs a Super Quader (Schlesischer Ueberquader) the age of which, however, is Lower Senonian.

For the most part, the Cretaceous beds of these areas are but little disturbed, having usually only a gentle dip. Locally, however, especially

in Bohemia, steep dips are found. Throughout much of the region great basalt masses broke through the Cretaceous strata, forming extensive sheets and necks, the remains of which are now seen in the numerous basalt-capped peaks and knobs, which nearly everywhere characterize the district.

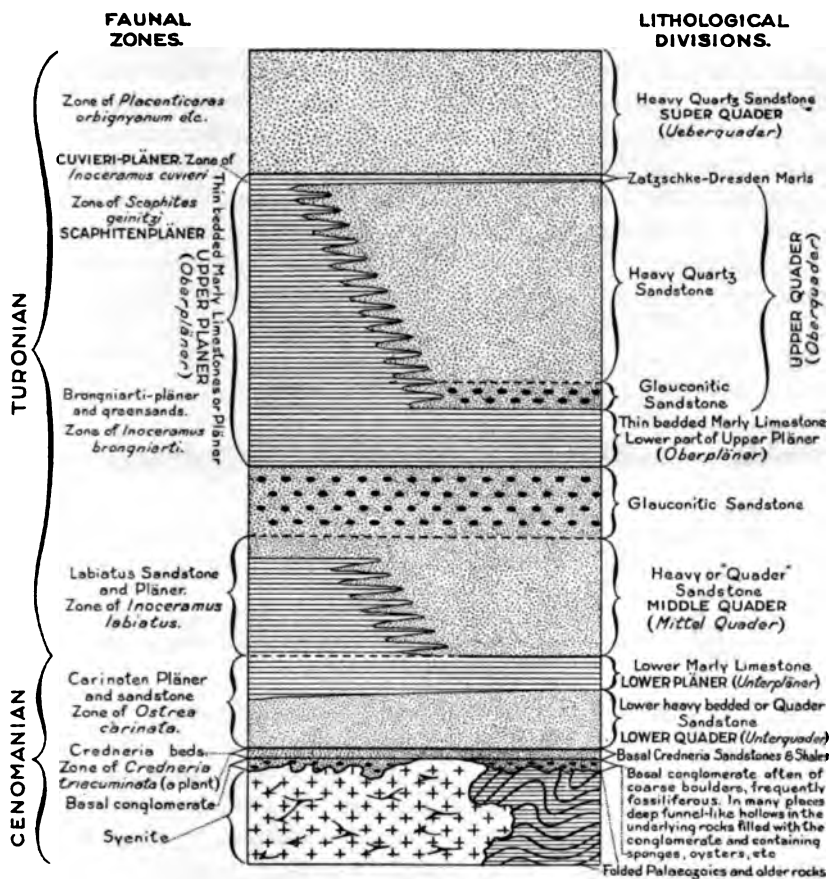


Fig. 4. Generalized Columnar Section of the Cretaceous of Saxony and Bohemia (Modified from Walther.)

Summarizing the Cretaceous deposits of this section, we see that sandstones predominate in the central region from north to south, and that these sands merge westward into greensands and more or less pure limestones, a similar though less pronounced change also occurring towards the north. (A generalized columnar section for Saxony and

Bohemia is given in Fig. 4; a cross-section in northern Bohemia in Fig. 5.) That a like transition to more open water sediments takes place towards the east is shown by the calcareous deposits of the Oppeln region, to be discussed next. This clearly points to a southward source of the sands which spread out as a series of great sandstone plains in the transgressing sea which lay to the northwest and east. That these sandstones were often deposited as delta plains above normal sea-level seems to be indicated by their frequent unfossiliferous character and by their well-marked torrential and, in places, eolian cross-bedding. There can be little doubt that these sands are traceable southward and south-eastward into the Vienna Sandstone, or Flysch, and into the Carpathian Sandstone, both of which are chiefly continental deposits, comprising a series of confluent river-flood plains and deltas which throughout Cretaceous and part of Tertiary time characterized the southern margin of the northern Cretaceous area of Europe.

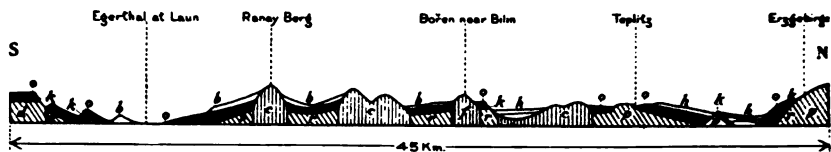


Fig. 5. Generalized Cross Section showing the highly disturbed Cretaceous Rocks of Bohemia and their Relation to the underlying beds. In the Leitmeritz Mittelgebirge, northern Bohemia. (After Krejčí, 1869.)

Crystallines: *r* (gneiss), *p* (porphyry); Permian formation *d*; Cretaceous: Perutz and Koritzan beds *k*, Weissenberg, Malnits and Teplitz beds *o*, Priesen beds *b*; Oligocene brown-coal *h*; basalt *c*; phonolite *f*.

The earliest stratigraphic and faunal work on Bohemia dates back to the papers by Reuss (1840, 1844, 1845-1846), but for details, sections, correlations, and faunal studies one must go to the classic *Studien im Gebiete der böhmischen Kreide-Formation* (see Frič, 1869, and Krejčí, 1869, especially) and to the recent correlation papers by Scupin (1907, 1912-1913). The sponges of Saxony have been described by H. B. Geinitz (1871-1875). The sponge faunas of Bohemia have been monographed by Počta (1883, 1884a, 1884b), who subsequently added more species to his earlier lists (Počta, 1890); additional shorter contributions have been made by Jahn (1891) and Čeněk Zahálka (1886b, 1887a, 1887b, 1888). From Počta's papers the author has compiled the following summary of the silicisponge faunas of Bohemia, showing the number of species at each horizon.

ORDERS	CENOMANIAN	TURONIAN		SENONIAN			
	Korytzan Formation	Weissenberg Formation	Malnitz Formation	Iser Formation	Teplitz Formation	Priesen Formation	Chlomek Formation
Hexactinellida	31	4	3	3	12	2	..
Lithistida	46	5	3	1	3	1	..
Tetractinellida	1	12	..	4	..	1	..
Monactinellida	4	5	..	6	1	..	..
Total number of species in each horizon	82	26	6	14	16	4	..

The number of species described and listed by Počta is as follows¹ (1884*b*, p. 38):

Hexactinellida	52
Lithistida	57
Tetractinellida	13
Monactinellida	7
	129

(5) The Cretaceous of Oppeln in Upper Silesia

This region is of especial interest to us on account of the great development of the sponge faunas which are so well represented in the Museum Collection. It is an isolated area on the Oder River, with the

¹All figures for the Calcareo and other orders are here omitted.

Upper Cretaceous rising from beneath the Tertiaries and younger beds and resting disconformably upon the great Triassic deposits which form the main mass of the Upper Silesian Plateau. That the series formerly extended much more widely is shown by the lithic character of the deposits which still remain.

The lowest known division of the Cretaceous in the Oppeln region is a sandstone of Cenomanian age shown on the banks of the Oder and found in borings to have a thickness of over forty-three meters. Beneath the sandstone is a gray-blue clay, which rests in turn upon the red shales of the Keuper. A limited outcrop of the Cenomanian is seen at Groeschowitz, southeast of Oppeln, and Cenomanian sandstones are also exposed in the neighborhood of Leobschütz, where, as at Oppeln, they consist of fine-grained, white quartz sands, in which fossils are rare. The rock is generally broken down into fine, white sand grains, among which glauconite grains are more or less common. Three subdivisions were made by F. Roemer, two of them being fine white sandstones, between which is a more glauconitic bed. This three-fold subdivision is, however, hardly constant. The lowest sandstone appears to represent a basal bed of a transgressing series, since it is of younger age in the Oppeln region than at Leobschütz eleven km. southwest of Oppeln, where it is of Lower Cenomanian age.

This sandstone contains plant remains described by Roemer (1870, p. 290) as:

Pinites lepidodendroides Roemer,
Arundites oppelensis Roemer,
Culmites sp.,
Fossil wood

There are also animal remains, among which are *Siphonia pyriformis* Goldfuss (see Roemer, 1870, Pl. xxviii, fig. 1) and *Siphonia* sp., as well as the following (1870, pp. 292 *et seq.*).

Isastræa sp.,
Catopygus carinatus Agassiz,
Rhynchonella sp.,
Inoceramus striatus Mantell (?),
Turrilites costatus Lamarck,
Ammonites (*Acanthoceras*) *rhotomagensis* Defrance.

The Cenomanian sandstone is succeeded by the Cretaceous marls of Oppeln, which are the main sponge-bearing formation. They are of Turonian age and have a total thickness of over forty-four meters, as

shown by borings (Leonard, 1897-1898, pp. 15, 16). Petrographically, the main portion of these beds is similar to the Pläner of Saxony, consisting mostly of marl. The strata are horizontal and rest upon the Cenomanian sandstone; no overlying beds are shown. Roemer has listed the following flora and fauna from this horizon (1870, pp. 299 *et seq.*).

- Plantæ: *Rhizodendron oppeliense* Göppert,
 Protopteris sternbergii Corda,
 Geinitzia cretacea Endlicher,
 Pinites species,
 Dicotyledonous leaves.
- Porifera: *Chenendopora tenuis* A. Roemer,
 Retispongia radiata Mantell,
 Cribrospongia fragilis A. Roemer,
 Camerospongia fungiformis (Goldfuss),
 Camerospongia megastoma F. Roemer,
 Siphonia elongata (Reuss),
 Limnorea nobilis A. Roemer,
 Plocoscyphia labyrinthica Reuss,
 Cylindrospongia angustata A. Roemer.
- Cœlenterata: *Parasmilia centralis* (Mantell).
- Echinodermata: *Micraster leskii* Desmoul,
 Micraster species,
 Ananchytes ovata Lamarck,
 Holaster planus (Mantell).
- Molluscoidea: *Terebratulula semiglobosa* Sowerby,
 Rhynchonella plicatilis Sowerby,
 Terebratulina striata d'Orbigny,
 Crania ignabergensis Retzius.
- Pelecypoda: *Ostrea hippopodium* Nilsson,
 Spondylus spinosus Deshayes,
 Spondylus striatus Goldfuss,
 Lima hoperi Mantell,
 Pecten dujardini A. Roemer,
 Pecten cretosus Defrance,
 Inoceramus latus Mantell,
 Inoceramus brongniarti Sowerby.
- Gastropoda: *Teredo amphibæna* (Goldfuss),
 Pleurotomaria linearis (Mantell).

Cephalopoda: *Nautilus elegans* Sowerby,
Ammonites peramplus Mantell,
Scaphites geinitzi d'Orbigny,
Helicoceras annulifer F. Roemer,
Helicoceras polyplocus (A. Roemer),
Hamites ellipticus Mantell,
Baculites anceps Lamarck (?).

Vertebrata: *Scalpellum maximum* Darwin (?),
Oxyrhina mantelli Agassiz,
Otodus appendiculatus Agassiz,
Ptychodus latissimus Agassiz,
Osmeroides lewesiensis Agassiz (?).

What appears to represent a higher horizon than the Cenomanian marls is found in a white sandstone discovered by borings beneath the Tertiary at Herrnprotsch on the Oder, twenty kilometers below Breslau. This was met with at a depth of 191 meters below the surface and was followed through a thickness of sixteen meters. Roemer placed this sandstone in the Cretaceous, because no other sandstones are found in this region, but that it is of Senonian age is doubted by Leonhard. It appears to indicate, nevertheless, a shoaling of the sea in Upper Turonian, in Emscher, or in Senonian time, with a return of the sand-bearing currents. Leonhard concludes that the isolation of the Silesian basin and its partial separation from the north German area, of which it was a prolongation, is shown by the remarkable depauperation of its fauna (Leonhard, 1897-1898, p. 22).

About seven miles south-southwest of Oppeln is another small inlier of Cretaceous beds at Leobschütz. The lowest rock exposed is a white sandstone with *Eragryra columba*. This is usually from 4.5 to 9 meters thick, and is made up of layers 7.6 cm. to 30 cm. thick composed of white or yellow sands with a siliceous cement. The sandstone rests unconformably upon the steeply inclined Culm and older formations and is usually covered by diluvium. It is Cenomanian in age, corresponding to the Quader sandstone of Saxony, but, unlike that formation, containing no siliceous sponges.

In this same region occur gray, sandy marls 0.9 to 6 meters in thickness with *Acanthoceras rhodomagense*, indicative of Upper Cenomanian age. These marls are horizontal and, as in the case of the sandstone with *Eragryra columba*, rest unconformably upon the steeply dipping Culm.

It is not unlikely that the two formations are merely different facies of the same stratum. In some places the marls are followed by the Tertiaries, but usually by the diluvium.

In the American Museum Collection there are twenty-seven specimens of sponges from Oppeln, representing fifteen species, thirteen of which are types. The pioneer work on the faunas of Silesia was done by Ferdinand Roemer (1870). More recently, Leonhard has discussed the stratigraphy and described the fauna, listing, with brief descriptions, six species of sponges (1897-1898, pp. 23-25), and R. N. Wegner (1913) has likewise made a valuable contribution. Schrammen (1910-1912) has noted the occurrence of many of the northwest German species in Oppeln.

(6) The Vienna Sandstone or Flysch¹ of the Wiener Wald and the Carpathians

The Flysch is, for the most part, a thin-bedded bluestone formation extending through the Lower and Upper Cretaceous and originating as a river delta, or series of confluent deltas formed by streams flowing from the mountainous mass which separated the north and the south European Cretaceous seas. These deltas probably mark the sites of the mouths of the streams which brought the Quader sands into the Cretaceous sea. In the Flysch, plant remains are the chief fossils, though shells of marine organisms occasionally occur.

Along the northern flanks of the Carpathians the Lower Cretaceous is represented by marine shales, marls, and limestones, followed by sandstones and conglomerates for the most part unfossiliferous. The Upper Cretaceous is represented only by the Friedecker Baculite marl and the Baschka sandstone. The former contains only *Baculites faujasi*, the latter *Inoceramus* species and *Aptychus* species. The *Baculites* is typically Senonian, though also found at lower horizons, so that the age of these beds is somewhat in doubt.

(7) The Polish Area

On the east side of the Polish Jura ridge the Cretaceous is developed as a series of sandstones, marls, and lime-marls, the latter occasionally being chalky and containing flints.

¹For further details see Paul, 1898, *Jahrb. d. geol. Reichsanstalt*, XLVIII, p. 53.

The following subdivisions have been recognized:

UPPER.—White lime marl and chalky beds with flints: 9.1-12.2 m. at Krakau; 183 m. in borings at Wislica. Contains *Belemnitella mucronata*, *Micraster gibbus*, *Inoceramus crisei*, and sponges.

LOWER.—Chloritic sandstones passing into sandy marls, with *Galerites subrotundus* Agassiz; solid sandstones, fossils practically absent.

The sandy marls of the lower division in some sections contain *Discoidea subuculus* Desor, *Holaster*, *Marsupites testudinarius* Schlotheim, etc. (See Roemer, 1870, pp. 352-353). It is the white lime-marls which contain the sponge fauna (Roemer, 1870, p. 355).

The Polish Cretaceous is related most closely to that of the Baltic province and is distinct from that of the Bohemian-Saxon basin and from that of Silesia.

(8) The Central Russian Basin

The Upper Cretaceous of this basin covers an immense area reaching from Orenburg to the Vistula and shows an unusually great development, considering that it is all marine, so that in places it rivals and even surpasses the thickness attained in the British Isles. Thus at Charkow, in the government of Charkow, southern Russia, it is 600 meters thick. The lithologic and faunal development is similar to that in western Europe. The Cenomanian, which is not so thick as the higher formations, is represented by greensands carrying *Schloenbachia varians*. The Turonian consists of limey or chalky marls, with various species of *Inoceramus* such as *brongniarti*, *cuvieri*, etc. The Emscher marl has been recognized and contains the usual *Inoceramus involutus* and *Actinocamax westphalicus*.

The Senonian is the most widespread of the formations, being developed either as a marl, e. g., the baculite-bearing marls of Lemburg, or as a true chalk, as in the government of Simbirsk, where the sponges are found, and at Charkow and in the Donetz basin. It is doubtful if there is any Danian in this region.

The Silicispongiæ of Russia have been described by Fischer-de-Waldheim, who identified a single species, *Siphonia pyriformis* Goldfuss, from the chalk at Bouchevoë, near Moscow (1837, p. 176), and described five new species of *Caloptychium*, three (*C. truncatum*, *C. münsteri*, and *C. eichwaldi*) from the Chloritic Chalk of Yazikova in the government of Simbirsk and two (*C. goldfussi* and *C. jasikorii*) from the Chalk Marl of Chilovka, also in Simbirsk (1844, pp. 278-283). In the second volume of

the 'Lethæa Rossica,' Eichwald (1865) described the sponge fauna of the Jurassic and Cretacic of Russia and subsequently Trautschold described two new species (1877) and noted the occurrence of three others in the Upper Cretaceous (1877, 1878).

(9) The Baltic Province

This includes the Chalk deposits of Rügen, Usedom, and Wollin, and the outliers in the vicinity of Mecklenburg. Here, too, are to be classed the deposits of Bornholm, Denmark (Stolley, 1892), and Scania.

On Rügen true chalk is found well exposed in the sea cliffs. It contains layers of flint and is characterized by echinoids of the genera *Ananchytes*, *Micraster*, *Galerites*, *Cidaris* and *Cyphosoma*, and by *Gryphaea vesicularis*, *Spondylus fimbriatus*, *Terebratulula cornea*, Bryozoa, and *Belemnitella mucronata*. The beds containing the last mentioned fossil are Upper Senonian and are to be correlated with the Mucronatenkreide of northwest Germany. Lower Senonian, or Quadratenkreide, seems to be wanting, but near Greifswald borings show Turonian, Cenomanian, and Gault.

The chalk beds of Usedom and Wollin with *Inoceramus brongniarti* belong to the Turonian, while the numerous scattered outcrops near Mecklenburg (Geinitz, 1888) represent mainly Senonian, though Turonian and Cenomanian also occur. Glauconitic marls of Emscher age with *Actinocamax granulatus* (Granulatenkreide) have been found near Revahl in inner Pomerania (Hinterpommern). The Cretaceous rocks and faunas of the island of Wollin were first described by G. Behrens (1878), although Hebert in 1869 and Schlüter in 1876 had mentioned the Cretaceous of Wollin in their correlations. On the basis of faunal studies, Behrens showed that the Wolliner limestone belonged to the Scaphites Pläner horizon (1878, pp. 265, 267).

In the province of Scania, in southern Sweden, siliceous sponges have been collected from the *Schreibkreide*, or chalk, at six localities near Malmö. Holst, the government geologist in Stockholm, sent the material to Schrammen to identify. The specimens are silicified and the skeleton is usually destroyed but, by a comparison with the sponges of northwest Germany, Schrammen was able to determine twenty-five distinct species, nine of which also occur in Germany, the others being called only "new species" but, on account of their poor preservation, not receiving new names (Schrammen 1910-1912, pp. 353-354).

Friedrich von Hagenow described the Cretaceous of Rügen in 1839 and especially mentioned the fine exposures shown along the coast north

and south of Sassnitz. There are two specimens in the Schrammen Collection from this locality. Hagenow identified nineteen species of sponges from Rügen, but did not specify which came from Sassnitz.

(10) The Prussian Region

In west and east Prussia the Cretaceous is known only from borings which show a thickness of over 300 meters. Cenomanian, Emscher, and Lower and Upper Senonian are indicated¹ but, to my knowledge, no sponges have been found.

(11) The South European (Mediterranean) Cretaceous Area

This includes the Cretaceous of the Alps, from southern France eastwards, and the deposits in northern Africa and Asia.

The deposits of Lower Cretaceous time are characterized by the abundance of *Requienias*, *Monopleura*, and similar aberrant types of pelecypods; by peculiar ammonoids (*Crioceras*, *Ancyloceras*, *Macroscaphites*, *Hamites*, etc.); and by genera of normal ammonoids which held over from the Jurassic, such as *Phylloceras*, *Lytoceras*, etc. Enormous accumulations of foraminiferal limestones (*Orbitolina*) and coral reefs characterize this period.

The deposits of the Upper Cretaceous are especially marked by the dominance of the Rudistes (*Radiolites*, *Hippurites*, etc.). Frequently the whole formation is composed largely of Hippurite limestones, which form reef-like masses and pass laterally into clastic limestones with few fossils. The Upper Cretaceous is known as the *Seewer limestone* in the west Alps, the *Couches rouges* in the northwest Alps, the *Gosau formation* of the eastern Alps, the *Scaglia* of the southern Alps.

In age, these formations vary in different localities, not infrequently showing a transgressing basal portion. Beginning with Cenomanian, frequently the Turonian and higher divisions overlap, resting directly on the Lower Cretaceous or older rocks. Nevertheless, the Upper Cretaceous of the southern section is, on the whole, a depositional unit in which the pronounced lithologic variation characteristic of the northern area is not very strongly marked, while the various members present gradational features which make subdivision difficult.

In Istria, Krain, and Dalmatia, the *Rudistes* limestones are followed by brackish- and fresh-water formations (*Cosina* beds) of late Cretaceous age, designated the Liburnian stage. They mark a retreat of

¹For further details see Jentzsch, H. Der vorvulviale Untergrund des norddeutschen Flachlandes. *Jahrb. d. preuss. geol. Landesanstalt* für 1899, p. 266.

the sea and a gradual replacement of the marine by continental sediments, as is indicated by the presence of coal beds in some of these formations. That this change towards the end of the Cretaceous was widespread, even in the Mediterranean area, is shown by the intercalation of similar fresh-water beds in the upper marine Cretaceous formations of Aja in Bakony, in Portugal, and in Provence, southeast France, where, near Aix, Fuveau, etc., these terrestrial beds reach a thickness of 800 meters and contain brown-coal and enclose brackish-water Mollusca. This retreat of the sea corresponds to that shown by the advance of the sands in southern Germany and in Bohemia in Senonian time and by the development of the continental Laramie deposits which mark the closing stages of the American Cretacic.

In north Africa (Egypt, Libyan desert) and in Palestine, the Cretaceous begins with the non-marine Nubian sandstone, which contains chiefly silicified woods and which was transformed into a basal bed by the transgressing Cenomanian sea, the calcareous beds of which rest directly and conformably upon it. "In Mount Lebanon where this sandstone is 1600 feet thick, it is succeeded by Turonian strata, while in the Libyan desert Senonian chalk follows it, making the age of the sandstone itself probably Turonian."¹ The Nubian sandstone thus rose diagonally across the successive divisions as a basal sandstone and continued as a basal transgressing member into Senonian time. Uppermost Senonian (Mæstrichtian) and even Danian are known from upper Egypt, where they are of typical marine character.

There are very few references in the literature to *Silicispongiae* in the rocks of this vast southern province, yet we have seen that they occur in southeastern France in abundance throughout the entire Cretaceous and it is not at all improbable that when the rocks of this age in Africa and in Italy and the Balkans are searched for siliceous sponges this phylum will be found to have been as well represented in ancient Tethys as in the boreal sea.

OUTLINE OF THE PALÆOGEOGRAPHY OF EUROPE IN CRETACEOUS TIME

During the Lower Cretaceous or Comanchic period, the south of Europe was covered in the main by a large mediterranean (the Tethys of Suess) which extended southward into north Africa and northward to the present plains of the Danube. A number of island masses rose

¹Grabau, A. W. 1906. Types of sedimentary overlap, Bull. Geol. Soc. Amer., XVII, p. 593.

from this sea, the chief of these being (Kilian, 1907, pp. 101-104): (1) the Iberian *méseta* (Spain); (2) the Central Alps (?); (3) Sardinian island including Corsica; (4) Caucasian island (?); (5) East Hungarian island; (6) Dinarian island; (7) Macedonian island; (8) Megarian island; and (9) the island of Asia Minor. This ancient mediterranean contained an abundant fauna consisting of ammonites and other Mollusca, especially the thick-shelled, often more or less spirally twisted pelecypods which, from their massive and coarse teeth, are grouped together as *Pachydonta* (e. g., *Disceras*, Upper Jurassic; *Requienia*, *Monopleura*, etc., Lower Cretaceous; *Caprina*, *Plagioptychus*, *Radolites*, *Hippurites*, Upper Cretaceous), and of corals, echinoids, Orbitolinas, etc. Some of these organisms, particularly the corals and sedentary molluscs, formed reefs, as shown in the Urgonian reef facies. A northern or boreal sea covered parts of north Europe, including western England, northern France, northwest Germany, parts of the Baltic region, and a portion of the Russian area. This sea was at times connected with the Mediterranean region on the east by the Volga straits, and on the west by way of Dijon and the Paris Basin. No direct connection appears to have existed in the earlier part of Lower Cretaceous time between the Russian and Baltic regions (which latter formed an embayment from the North Sea of today), though during the earlier periods both areas were united by the waters which then covered the Arctic regions around the northern Scandinavian border. This connection was, however, non-existent during the period of the Gault, when various pathways across middle Europe were opened by the beginning of that great transgression which became so marked in Cenomanian and Turonian time.

The land mass which separated Tethys from the northern Cretaceous sea and which was partly submerged and dismembered in Upper Cretaceous time comprises the Vosges mountains, the Ardennes, the Black Forest, the Hunsrück, and Thuringerwald, or the central portion of the Post-Cretaceous Rhenish dome, as well as the Bohemian mass, the Sudetic mountains, and other parts of Silesia, Poland, and a part of south Russia. To the north of the Baltic region was the great Fenno-Scandian land mass, which also included part of northwest Russia.

Only in the Alpine region of the Mediterranean was there continuous deposition of marine beds from the Jurassic into the Lower Cretaceous; elsewhere the evidence of a great regression of the Jurassic sea is indicated, and either erosion or the deposition of continental beds (Wealden, etc.) marks the interval before the retransgression of the sea

in Lower Cretaceous time. This transgression brought with it marked overlaps and basal deposits which rise in age from point to point in the direction of transgression. Such a basal bed of the transgressing Lower Cretaceous sea is found in the Hils formation of northern Germany. It consists of sandstones and conglomerates at the base and rests, generally with a marked hiatus, upon the Upper Jurassic (from the Kimmeridgian to the Purbeckian), of which it commonly contains pebbles and worn fossils. The age of the Hils itself varies from point to point, as is shown by the age of the succeeding fossiliferous formations in various localities.

The transgression continued with more or less interruption into Upper Cretaceous time where, during the Cenomanian, it became so pronounced that beds of this age over much of northern Europe rest directly upon the older formations, even upon the folded and eroded Palæozoics and in some sections upon the crystallines. This great transgression is widely recognized throughout northwest Europe and is generally spoken of as the Cenomanian transgression, although it only marks the culmination of the broad positive eustatic movement inaugurated in Lower Cretaceous time. The cause of this wide extent of the Cenomanian and later deposits is, no doubt, due to the completion of the peneplane which beveled the Palæozoic mountains, these, up to that time, having formed effective barriers to the advance of the Lower Cretaceous sea. An instructive and typical example of the Cenomanian transgression in the British Cretaceous has been worked out by Professor Grabau from whom I quote.¹

In England the basal formation is the lower Greensand (Aptian), which rests on the non-marine Wealden, and is a glauconite and clay formation with basal conglomerates. The corresponding lithic bed in Antrim county, Ireland, is the Cenomanian, which rests on Lias and Rhætic. The distance is from 300 to 400 miles, in which interval the lower Greensand and Gault have disappeared by overlap, bringing the Cenomanian directly on the old land surface. During the advance, however, the deepening of the English area, and above all the removal of the coast, permitted the deposition of chalk in that region, so that the Cenomanian of England is a chalk, though it still contains Greensand and marl. It is the Lower Chalk of the British geologists. The corresponding lithic bed of Ireland—that is, the Lower Chalk of Ireland, lithically considered—is lower Senonian. Between this and the basal Lower Greensand (Cenomanian of Ireland, Aptian of England) is a glauconitic sand, clay, and marl formation, which in England is the Gault or Upper Greensand (Albian), while in Ireland it is the Turonian, and in part perhaps Upper Cenomanian. The Turonian, or Middle Chalk of England, is already a pure white chalk, a lithic

¹Grabau, A. W. 1906. Types of sedimentary overlap, Bull. Geol. Soc. Amer., XVII, p. 592.

characteristic attained in Ireland only in the upper Senonian. Thus a regular and progressive advance of the sea from southeast to northwest is indicated, with a corresponding change in lithic character as the sea advanced.

The transgressive character of the deposits of Upper Cretaceous time against the northern border of the north Cretaceous basin is seen in the remarkable basal conglomerates which are found in the Scanian district of Sweden. At Tosterup and elsewhere in Scania the conglomerates contain *Actinocamax mamillatus* and thus represent the Quadratenkreide of Lower Senonian age, which here rests directly upon much older beds. At Küllernölla (Scania) lower beds with *Actinocamax granulatus* (Granulatenkreide) occur, while Emscher greensand is found on Bornholm. Farther north in Sweden the basal conglomeratic beds (Trümmerkreide) are of Upper Senonian age (Mucronatenkreide), thus showing essentially a northward overlap.

That the Cenomanian transgression was also, though perhaps less strongly marked, in the Mediterranean region is shown by the overlaps there against the northern land barriers, of the several members of the more uniform southern Upper Cretaceous formations, as well as by the fact that in many sections the Upper Cretaceous alone is present, having overlapped the Lower, as already noted in the preceding section.

The continued transgression from Cenomanian to Senonian time over the southern border of the Mediterranean basin is well shown by the Nubian sandstone of North Africa and Palestine, which is successively followed by Cenomanian, Turonian, and Senonian formations in the direction of transgression (see p. 93 above).

In the northern basin, in addition to the marine deposits, there was also accumulated a remarkable series of continental sediments which were built out into the basin by rivers flowing from the old mountain systems. These fluvial deposits of sand, containing almost no other organic remains but Chondrites—commonly referred to the Algæ, but possibly a land plant—were continuous in their deposition from Lower Cretaceous on through Upper Cretaceous, and indeed into Tertiary time, and are known by the broad name of Flysch. They form a thick series of continental deposits best developed in the Vienna basin, for which reason they are there called the Wiener Flysch or Wiener Sandstein, while to the southeast they are designated the Carpathian Sandstone. This inpouring of river-borne sands retarded and at times neutralized the southward transgressive movement of the Cretaceous sea, besides furnishing it with the sands which now constitute the several quadersandstones of Bohemia, Saxony, and Silesia, and the

Senonian sands of similar origin and lithology found in the northwest of Germany. Thus the history of Upper Cretaceous time may well be looked upon as a record of the struggle between the sea, which was attempting to encroach upon the land, and the rivers, which by their deposition of large amounts of detritus were able not only to prevent the sea from advancing but even to load up the littoral zone with more waste material than the waves could remove, so that slowly but surely the sea was pushed back northward in the last stages of the Upper Cretaceous, that is in late Senonian time, until it was forced out of the greater part of northern Europe. The resultant retreat was probably not eustatic in origin, as had been the Cenomanian advance which was due to a world-wide transgressive movement of the sea; rather was the late Senonian retreat from northern Europe in response to the synchronous broad advance over Great Britain, marked by the deposition of chalk in England, Scotland, and Ireland, and perhaps to some extent in response to a similar advance in the Mediterranean basin. The Senonian changes of sea-level in the northern basin seem thus to have been compensatory in their nature, the retreat in Germany corresponding to the advance in the British area. A cross-section from Vienna to northern Ireland would show the advance of the continental sands over the marine beds. In Vienna the entire Upper Cretaceous is of continental or near-shore origin, but northwestward, as in the Elbthal, the Cenomanian is marine, showing the farthest southward advance of the sea, for all the higher beds were probably in part at least continental, though now largely removed by erosion. In northwestern Germany the sea held its own through Cenomanian and Turonian time, but in the Upper Senonian the advancing sands from the south filled up the sea margin and the marine waters were forced still farther north. The relation here indicated is one of "replacing overlap," as defined by Professor Grabau.

CHAPTER IV.—NOTES ON THE GENERA AND SPECIES IN THE SCHRAMMEN COLLECTION IN THE AMERICAN MUSEUM OF NATURAL HISTORY

INTRODUCTION

The Schrammen Collection of Cretaceous *Silicispongiae* contains 800 specimens representing 116 genera including 218 species, one variety, and three mutations. The collection of type species is the one which was purchased by The American Museum of Natural History in 1914 from Doctor Anton Schrammen. Prior to that date, in 1903, a smaller

collection had been purchased consisting of 300 specimens representing 171 species. Many of these are icotypes, a few are apotypes and some may be proterotypes (see definitions below), but it has been impossible, in most cases, to determine which kinds of types, if any, the specimens represented. Furthermore, even the supplementary types are only duplicates of the types of the same or higher order in the 1914 collection. With the exception, therefore, of about half a dozen specimens, no part of the 1903 purchase is included among the types now exhibited in the center cases Nos. TTC-17 and 18 in the Hall of Geology and Invertebrate Palæontology, and what few apotypes there are have been set aside to be incorporated in a zoological exhibition of the *Silicispongiæ*.

The specimens in the collection are arranged primarily upon a stratigraphic basis from the oldest to the youngest of the Cretaceous formations represented. Further subdivision is made upon the geographical occurrence, all of the specimens of the same age from the same locality being placed together. For each locality the arrangement of the species is zoological, the order used by Schrammen in his *Monograph* having been followed. For the convenience of students who desire to refer quickly to the monograph, page references are given in parentheses after each species in the following discussion. In referring to the common works on sponges, the abbreviations which are customary in the literature will be employed, but the name of the author and the date of his work will always be given, so that the complete reference may be found by consulting the bibliography at the end of this paper.

All of the specimens come from the Upper Cretaceous of northwest Germany, from the provinces of Hanover, Saxony, and Silesia, and two from the Island of Rügen. Less than one-fourth of the specimens come from the Turonian, twenty species from the Emscher-Mergel and the remainder or over three-fourths come from the *Quadratenkreide* and *Mucronatenkreide*, or zones 3 and 4, respectively, according to Stolley's classification of the Senonian.

In the notes on the individual species the references to the literature usually, but not always, constitute complete synonymies. All references affecting the status of the genus and species are taken account of, but I have not in every case incorporated all notices in the literature of the occurrences of species in different localities when such notices include no change in synonymy. The object of the present paper is to determine the status of the types in the collection, not to make complete synonymies for the species. During the progress of the work, over four thousand references to species have been accumulated, and at some later date it is

the intention of the author to assemble and pass judgment upon these and all other available references to European Cretaceous sponges and to publish a complete synonymy thereof. That, however, will be a work of years, not of months, and will necessitate, probably, the consultation of the types in the European museums, as well as of a great mass of literature not to be found in this country.

Classification of Types

The following classification of types, proposed in large part by Schuchert and Buckman,¹ and slightly modified by Grabau,² is the one used in the arrangement of the collection.

I. PRIMARY TYPES (Proterotypes)

- (1) **Holotype.**—The original specimen selected as the type and from which the original description (protolog), or the original illustration (proto-graph), is made.
- (2) **Cotype.**—A specimen of the original series when there is no holotype, the describer having used a number of specimens as of equal value.
- (3) **Paratype.**—A specimen of the original series when there is a holotype.
- (4) **Lectotype.**—A specimen chosen from the cotypes subsequent to the original description to represent the holotype.

II. SUPPLEMENTARY TYPES (Apotypes)

- (5) **Heautotype.**—A specimen figured or described by an author as a further illustration of his own already founded species, such not belonging to the proterotypes.
- (6) **Plesiotype.**—A similar specimen, but selected by some one else than the original describer of the species.
- (7) **Neotype.**—A specimen identified with an already described and named species and selected to represent the holotype in case the original material is lost or too imperfect for determination.

¹Schuchert, Charles and Buckman, S. S. 1905. The nomenclature of types in natural history. *Science*, N. S. XXI, No. 545, pp. 899-901. See also 'Catalogue of the Type and Figured Specimens of Fossils, Minerals, Rocks and Ores in the Department of Geology, United States National Museum, Washington,' 1905, pp. 10-18.

²Grabau, A. W. 1913. *Principles of Stratigraphy*. New York, pp. 918-920.

III. TYPICAL SPECIMENS (Icotypes)

- (8) Topotype.—A specimen (not used in the literature) from the same locality and horizon as the holotype (or other proterotype) or lectotype.
- (9) Metatype.—A topotype identified by the nomenclator himself.
- (10) Idiotype.—A specimen (not used in the literature) identified by the nomenclator himself, but not from the original locality or horizon of the proterotype with which it is identified, i. e., not a topotype.
- (11) Homœotype.—A specimen (not used in the literature) identified by a specialist, after comparison with one of the proterotypes.
- (12) Chirotype.—A specimen upon which a chironym or manuscript name (a name never published) is based.

IV. CASTS OF TYPES (Plastotypes)

- (13) Plastotype.—Casts of types may or may not be used in descriptions or illustrations.

GENOHOLOTYPE.—The original species on which the genus is founded, or the species selected by the author from those originally described as the type of the genus.

GENOSYNTYPE.—One of a series of species upon which a genus is founded, when there is no genoholotype.

Of the total representation of 377 species from all the localities¹ 358 are types. These are distributed as follows:

I. Primary Types

(1) Holotypes: 1 figured, 4 (spicules only)	5	
(2) Cotypes: 41 + 1 ? + 2 figured	43	
(3) Paratypes: 38	38	
		86

II. Supplementary Types

(5) Heautotypes: 14	14	
(6) Plesiotypes: 169	169	
		183

¹Many of the species occur at several localities so that there is a duplication. Of separate species (or varieties) there are only 222.

III. Typical Specimens

(7) Topotypes: 1	1
(8) Metatypes: 10+1 ?	11
(9) Homœotypes: 9	9
(10) Idiotypes: 21	21
(11) Chirotypes: 10	10

52

Absolute Determination Not Possible

Holotype or Metatype: 1	1
Paratypes or Metatypes: 3	3
Paratypes or Heautotypes: 19	19
Cotypes or Heautotypes: 14	14

37

Total 358

SPONGES FROM THE TURONIAN OR OBERER PLÄNER

The Scaphites Pläner (Strombeck's Zone 4 of the Turonian;
Schlüter's Zone 2 or Lamarcki Pläner)

SPECIES FROM HALBERSTADT, SAXONY

18180.—*Doryderma* (*Brochodora*) *roemeri* (Hinde) (p. 58). PLESIOTYPE

The generic name *Doryderma* was proposed by Zittel in 1878 to include *Spongia* of Phillips, part of Roemer's *Polyjerea* and part of Pomel's *Dichojerea*. The first species which he lists under *Doryderma* is *Polyjerea dichotoma* Roemer from the Mucronatenkreide of Ahlten (1878, p. 131, Pl. VII, figs. 1, a, b, c, d, e). Here, too, he includes the forms identified by Quenstedt as *Polyjerea dichotoma* Roemer ('Petrefactenkunde,' V, 1878, p. 423, Pl. CXXXV, figs. 10, 11), forms which came from the lower Turonian, the Middle Pläner (Cuvierikreide), of Windmühlenberg, near Salzgitter, Hanover.

For Roemer's species as revised by Zittel, Hinde in 1883 ("Catalogue of Fossil Sponges," p. 49) proposed the name *Doryderma roemeri* for the following reason. Miss Benett in her 'Catalogue of the Fossils of Wilts' had named and figured a sponge from the Upper Greensand of Warminster, Wiltshire, as *Polypothechia dichotoma* (1831, p. 9, Pl. XIII). Hinde found that this species belonged to Zittel's genus *Doryderma*, for which reason Miss Benett's usage of *dichotoma* claimed priority. Thus it was necessary to assign a new name to the German species described by Roemer and consequently Hinde proposed the specific designation *roemeri* in memory of the discoverer of the species.

Hinde's holotype was a fragmentary specimen from a chalk flint supposed to have come from the Upper Chalk of Wiltshire (protograph, 1883, Pl. VIII, figs. 3, 3a; two spicules from Ahlten, Hanover, also illustrated, Pl. VIII, fig. 3b). Hinde, for what reason he does not state, includes under his species Parkinson's material which was figured in the 'Organic Remains' (1808, II, Pl. VII, figs. 7, 12) and described as a "ramose alcyonite from Berkshire" (*loc. cit.*, p. 91). Although Quenstedt ('Petrefactenkunde,' V, 1878, p. 400) states that Mantell was referring to Parkinson's species when he gave the name *Spongia ramosa*, Hinde does not consider this to be the case (1883, p. 49). Since he had Mantell's types and presumably those of Parkinson, we must, until better information is available, accept Hinde's synonymy. He considers that F. A. Roemer's *Polyjerea dichotoma* (1864, p. 36, Pl. XIV, fig. 1), described from the Cuvierkreide of Salzgitter, the Quadratenkreide of Wahrenberge near Biewende, in the Köhlerholz near Ilsenburg, and from the Mucronatenkreide of Ahlten, is the same as Parkinson's "ramose alcyonite," although Roemer himself had given no such synonymical reference. Parkinson's figures and description certainly do not seem to warrant Hinde's procedure but, if he had the types, as we may with considerable certainty assume, and since he had specimens of Roemer's species presented by Zittel to the British Museum, then we may assume that he was justified in putting Parkinson's and Roemer's species in the same synonymy.

Schrammen, in his Monograph, separates from Zittel's *Doryderma* two subgenera, *Brochodora* and *Homalodora*, the former characterized by a coarsely porous skeleton and a surface covered with large, skeletal, net-like meshes lying one on top of the other and serving as ostia, while *Homalodora* is characterized by a dense skeleton and a smooth, fine-meshed surface, with irregularly spaced, round ostia (1910-1912, pp. 58, 59). In the subgenus *Brochodora* Schrammen places *Doryderma roemeri* Hinde. Without giving any explanation, he includes in his synonymy of the species the forms identified by Wollemaun from the Senonian of Gr. and Kl. Biewende, Braunschweig, as *Doryderma ramosa* Mantell (Wollemaun, 1900, p. 5). It may be stated that Schrammen placed this species in his synonymy in accordance with the description given by him for the subgenus *Brochodora*, for Wollemaun distinctly calls attention to the fact that it is the meshes of the net-work which serve as ostia and this characteristic is diagnostic of *Brochodora*, while the true *Doryderma ramosa* Mantell has well-developed ostia and is, therefore, placed in the subgenus *Homalodora*.

Schrammen has added to the localities from which this species was already known Nettlingen, Halberstadt, Misburg, Oberg, and Adenstedt. The specimen which he figured is from the Quadratenkreide of Oberg (*loc. cit.*, Pl. XVIII, fig. 5, text plate II, fig. 1). Since Schrammen revised and further described and illustrated the species, the specimens from Germany which he used are plesiotypes.

18181. ***Thecosiphonia torgeri*** Schrammen (p. 83).

COTYPE

This species was described by Schrammen in 1910 from the Scaphites Pläner of Halberstadt and Nettlingen, from which localities he had examined twenty specimens. Since he published no figures of the species and designated no holotype, all of the specimens are cotypes.

18182. ***Jerea quenstedti*** von Zittel (p. 89).

PLESIOTYPES

This species was described by Goldfuss (1833, p. 221, Pl. LXV, fig. 14) as *Siphonia ficus* from the Quadersandstein of Quedlinburg, Saxony. Roemer in 1864 (p. 27) simply lists the species with a brief description but does not note occurrences. Quenstedt (1878) records it from the Pläner of Quedlinburg and states that it had been described by Parkinson (1808, p. 95, Pl. IX, fig. 4) as *Alcyonium ficus* from the Chalk of Wiltshire. Parkinson quite rightly takes no credit for proposing the name but ascribes it to Linnaeus. It is to be noted that Linnaeus (1792, *Systema Naturæ*, I, pars VI, p. 3813) used the name *Alcyonium ficus* only for living forms; Mantell was the first to identify a fossil sponge under the Linnean name. In 1821 Lamouroux (p. 79, Pl. LXXXVIII, fig. 3) described the genus *Jerea* with *J. pyriformis* as the genoholotype. It is to this genus that Zittel ('Studien,' 1878, II, p. 145) ascribes Quenstedt's species *Siphonia ficus* and, at the same time, he changes the specific name to *quenstedti* without stating his reasons. Schrammen, however, explains this apparent error in the recognition of priority (1910, p. 90). Schrammen considers that *Siphonia ficus* Goldfuss and *Siphonia ficus* Quenstedt are the same because he feels that there is the highest probability that the type specimens came from the same horizon—indeed, both were described from the Turonian of Quedlinburg—and, furthermore, the descriptions of the two species are closely parallel. There is also no doubt that *Siphonia ficus* Quenstedt is synonymous with *Jerea quenstedti* Zittel. Zittel, however, held that the *Siphonia* of Goldfuss and of Quenstedt belonged to separate genera, and left *Siphonia ficus* Goldfuss under that name (Zittel, 1878, p. 143) as a representative species of *Siphonia* but he gave a new name to Quenstedt's *Siphonia*

ficus. Now, if, as Schrammen thinks to be the case, there is no difference between *Siphonia ficus* Goldfuss and *Siphonia ficus* Quenstedt, then, by the laws of priority, Goldfuss' name would have priority and Zittel's would have to be dropped from the literature. The reason that Schrammen does not recognize Goldfuss' apparent claim to priority is that the locality given by Goldfuss is indefinite and the figure is too schematic to be perfectly certain of the identity of the species.

In 1841 Roemer (1841, p. 4) noted the occurrence of *Siphonia ficus* Goldfuss from Sudmerberg, near Goslar, Hanover, but Schrammen states that it is apparent from the description that Roemer had another species in mind.

Schrammen also points out that Griepenkerl is wrong in his identification of material from the Quadratenkreide of Glentorf, Braunschweig, as *Siphonia ficus* Goldfuss, for the paragaster in the Griepenkerl specimen is not deeply sunk but only as deep as, or a little less deep than, broad.

Hinde (1883, p. 65) has described and figured (Pl. XIII, figs. 3, 3a), specimens from the Grey Chalk (Cenomanian) near Dover, which he calls *Siphonia ficus* Goldfuss. Hinde, accepting Zittel's revision, lists *Jerea quenstedti* Zittel (p. 71) as distinct from the species just mentioned but, if we accept Schrammen's revision, the two will appear in the same synonymy.

Pořta (1884, p. 34) lists *Siphonia ficus* Goldfuss from the Malnitz beds of Leneschitz and from the Korytzan beds of Bilin in Bohemia. These occurrences are also to be included under *Jerea quenstedti* Zittel.

In 1901 Schrammen described a new genus, *Pachycalymma*, with the genoholotype and sole species *P. subglobosa* (pp. 9, 10, Pl. I, fig. 1, Pl. III, fig. 1, Pl. IV, fig. 4). After studying better material, Schrammen, at the time of publication of his Monograph, came to the conclusion that this species was in reality a *Jerea quenstedti* and represented simply young individuals in which the epitheca (Deckschicht) was especially well preserved. His former genus, *Pachycalymma*, is therefore a *nomen nudum*. From the Quadratenkreide of Oberg, Schrammen figured four specimens and some spicules (1910, Pl. II, figs. 1-4, text plate IV, fig. 2).

18183. *Pachycothon giganteum* (Roemer) (p. 130).

PLESIOTYPE

This species was described by Roemer in 1864 as *Cupulospongia gigantea* (p. 51, Pl. XVIII, fig. 1) from the Quadratenkreide of Suderode. Zittel in 1878 ('Studien,' II, p. 132) erected the genus *Carterella* to include parts of *Jerea* of Roemer and Gumbel and under this he included

Jerea spiculigera of Roemer, which had been described by that author in 1864 (p. 34, Pl. XII, fig. 6) from the Cuvierkreide of Windmühlenberg near Saltzgitter. Schrammen includes in his synonymy the species designated under the Zittel revision as *Carterella spiculigera* (1910, p. 130) but, since this was Roemer's *Jerea spiculigera*, then Schrammen should include this also in his synonymy. Hinde (1883, p. 55) notes the presence in the British Museum of spicules of *Carterella spiculigera* (Roemer) from the Zittel Collection from Ahlten, Hanover. This is also included in the synonymy given by Schrammen for *Pachycothon giganteum*. Schrammen does not make clear in his Monograph why he includes these species in his synonymy, but in 1901, when he described the genus *Pachycothon*, he made his genoholotype *giganteum*.¹ At that time, however, he made the mistake of ascribing the species to himself, but this error he rectified in 1910. He calls attention in 1901 to the fact that Zittel had placed Roemer's *Cupulospongia gigantea* under *Seliscothon* (1878, 'Studien,' II, p. 118) without, however, having seen the types in the Roemer Museum. Yet, in 1910, Schrammen fails to include in his synonymy *Seliscothon giganteum* (Roemer) emend Zittel, as he should have done. *Carterella spiculigera* Zittel is only a stem of *Pachycothon giganteum* (1910, p. 130).

In 1890 Poëta described a new species *Isoraphinia simplicissima* from the Cuvieri Pläner of Paderborn, Westphalia (1890, p. 229), a species which Schrammen includes in his synonymy of *Pachycothon giganteum* without stating his reasons. The figures given by Poëta are very poor (*loc. cit.*, Pl. VI, figs. 1a, b).

This species ranges from the Scaphites Pläner through the Mucronatenkreide and occurs at Halberstadt, Nettlingen, Misburg, and Oberg, besides the localities already mentioned. The specimen figured by Schrammen is from the Quadratenkreide of Oberg (Pl. XVII, fig. 6).

18184. *Leiostracosia alcyonoides* (Mantell) (p. 284).

In 1808 Parkinson ('Organic Remains,' II, Pl. x, fig. 12) figured, without naming, "an alcyonite found in the chalk-pits of Wiltshire," and he gave a brief and insufficient description of the specimen on p. 213. Mantell, in 1822 ('Fossils of the South Downs,' p. 176), gave the name *Ventriculites alcyonoides* to this species. He notes that it is "rare in Sussex, but common in a contracted state at Heytesbury, Wiltshire" (p. 176); it occurs in the Upper Chalk at Lewes. Roemer

¹Through an error in proof reading this appears as *gigantenum* in 1901 (Neue Kieselschwämme, p. 12).

(1841, p. 9, Pl. iv, fig. 2) revised Phillips' species *Spongia cribrosa*, described from the Chalk of Yorkshire (1829, p. 118), and placed it under Schweigger's genus *Scyphia*, recording it from the Pläner of Goslar and Oppeln; this species is included by Schrammen in his synonymy of *Leiostracosia alcyonoides*.

Ferdinand Roemer (1870, p. 309, Pl. xxx, figs. 7, 8) identified certain specimens from Oppeln, Silesia, and from Schonau near Teplitz, Bohemia, as A. Roemer's *Scyphia angustata*, which he placed under the genus *Cylindrospongia*. As Hinde first pointed out (1883, p. 114), this species is not the same as the one originally called *Scyphia angustata* by F. A. Roemer (1841, p. 8, Pl. III, fig. 5) and now known as *Leiostracosia angustata* (q. v.) but really belongs under Mantell's species *alcyonoides*. Leonhard (1897, p. 31), while stating that *Ventriculites angustatus*, s. str. is *V. alcyonoides* Mantell according to Hinde, does not accept the Hinde revision nor does he allow the priority of species name to go to Mantell, but prefers to retain F. Roemer's 1870 designation, so that he speaks of *Ventriculites angustatus* A. Roemer when referring to the species called by Hinde *V. alcyonoides* Mantell, and he used Quenstedt's term *V. angustatus distortus* for the form called by A. Roemer in 1841 (p. 8) *Scyphia angustata*. The specific name *angustata* undoubtedly must be retained for the sponge described in 1841 and Quenstedt (1877, p. 44), therefore, was unjustified in erecting a new name for the 1841 species, and in retaining the original 1841 designation for the 1870 species of Roemer. Other authors, with the exception of Leonhard, have not followed Quenstedt in this.

Schrammen has made a final generic revision, placing both *angustata* and *alcyonoides* under his new genus *Leiostracosia*. He records *L. alcyonoides* from the Scaphites Pläner and the Cuvieri Pläner, from Oppeln, Dörnten, and Grosse Heere, but has not mentioned its occurrence in the Lamarcki Pläner of Halberstadt so that the specimen in the Collection is not a type.

18185. *Plocoscyphia roemeri* Leonhard (p. 300).

PLESIOTYPE

In 1844 Reuss (p. 173) described the species *Scyphia labyrinthica* from the Plänerkalk of Bohemia. In his work of the following year, 'Die Versteinerungen der Böhmisches Kreideformation' (1845, p. 77, Pl. XVIII, fig. 10) he erected the genus *Plocoscyphia* with this species as genoholotype. F. Roemer (1870, p. 309, Pl. xxxiii, figs. 7, 8) gives this species from the Turon Pläner of Oppeln. In 1877 Quenstedt (p. 485, Pl. cxxxviii, figs. 12, 13) placed Roemer's species under the

genus *Gyrispongia*, but this generic revision has not been recognized by authors. In 1897 Leonhard (1897, p. 35) pointed out that Roemer had made a mistake in identifying specimens from Oppeln with *Plocoscyphia labyrinthica* Reuss from Bohemia, a mistake due to the fact that Roemer had only crushed and incomplete specimens. Because of the mistaken identification, Leonhard proposed the new specific name *Plocoscyphia roemeri* for Roemer's *P. labyrinthica*.

Schrammen (1910, p. 300) records this species from Nettlingen, Oppeln, and Halberstadt, at all of which localities it occurs in the Scaphites Pläner.

18186. ***Plectascus clathratus*** (Roemer) (p. 308).

PLESIOTYPES

This was originally described as *Dendrospongia clathrata* by Roemer (1864, p. 20, Pl. VIII, fig. 5) from the Cuvieri beds of Windmühlenberg near Salzgitter. Schrammen records it from the Scaphites beds of Nettlingen and Halberstadt.

SPECIES FROM OPPELN, SILESIA

18187. ***Phymatella intumescens*** (Roemer) (p. 73).

HOMŒOTYPE

This specimen is from the collection purchased by the Museum from Schrammen in 1903. Nowhere in print does he refer to the occurrence of this species at Oppeln, although he records its presence in the Scaphites Pläner of Heere, Salder, Nettlingen, and Halberstadt. It is quite likely that he had failed to take note of the occurrence at Oppeln before he sent away the specimens in 1903, so that when he published his Monograph this locality was not listed. The specimen is thus a homœotype.

18188. ***Thecosiphonia nobilis*** (Roemer) (p. 84).

PLESIOTYPES

This species were described by Roemer (1864, p. 37, Pl. xv, fig. 1) as *Limnorea nobilis* and is reported by him from the Cuvieri beds of Immenrode, Haverlah, and Immenstedt, and from the Quadratenkreide of Suderode. At the same time Roemer described another species, from the same localities and horizons, as *Tremospongia grandis* (1864, p. 40, Pl. xv, fig. 3). Zittel (1878, p. 148, Pl. x, fig. 3) described the genus *Thecosiphonia*, under which he included *Limnorea*, *pars*, and *Tremospongia*. Schrammen has gone even further in regard to *Tremospongia grandis*, not only accepting Zittel's generic revision, but placing the species under *Thecosiphonia nobilis*, the two being beyond doubt identical (Schrammen 1903b, p. 21). Schrammen gives as the reason for Roemer having made two distinct species the fact that in one case he

was dealing with a form with a very deep "Scheitel," in the other case with one the "Scheitel" of which had been truncated; but such differences are often observed in the same species and should not be made the basis for separation into distinct species, according to Schrammen. This species is recorded by Schrammen from the Cuvieri Pläner of Salder and Oppeln and he calls attention to the fact that Senonian beds with sponges are not developed at Suderode and that, therefore, the examples recorded by Roemer must have come from the Cuvieri beds at that locality (1910, p. 85).

18189. *Scytalia terebrata* (Phillips) (p. 150).

PLESIOTYPES

This species was named and figured by Phillips in 1829 (p. 118, Pl. I, fig. 10) as *Spongia terebrata* from the White Chalk of Danes' Dike, Yorkshire. The first description of the species was given by Hinde, who described a single specimen in the British Museum from the Upper Chalk of Flamborough ('Catalogue,' 1883, p. 45). This is three times as large as the specimen indicated in Phillips' illustration, for which reason Hinde thinks that Phillips must have made his drawing at one-third the natural scale.

Reuss in his 'Geognostische Skizzen aus Böhmen,' II, described the species *Cnemidium pertusum* (1844, p. 299) from the Lower Plänerkalk of Schillinge near Bilin, Bohemia. In the following year he again described the species giving many figures of it (1845-1846, p. 71, Pl. xvi, figs. 7, 8, 11-14). A. Roemer gave a brief description and poor figure of a form which he called *Jerea turbinata* from the Mucronatenkreide of Ahlten (1864, p. 32, Pl. xii, fig. 1). All of these species, together with *Spongia terebrata* Phillips, Zittel placed in his new genus *Scytalia* (1878, p. 128), figuring the skeletal elements of *Scytalia turbinata* (Roemer) (Pl. v, fig. 3). Schrammen, in his synonymy, not only accepts the Zittel generic revision but includes all of the species just discussed under *Scytalia terebrata*. He admits that there is an element of doubt in referring to *Cnemidium pertusum* Reuss and *Scytalia pertusa* (Reuss) of authors as a synonym of *Scytalia terebrata* (Phillips), for he had not examined any of the Bohemian material and was dependent solely upon descriptions and figures. His reason for making *S. pertusa* a synonym of *S. terebrata* seems to be insufficient; it is because he has found in the Cuvieri Pläner around Oppeln not only specimens which are indistinguishable from the typical *S. terebrata* but also specimens like those figured and described by Počta and described by Zahálka as *S. pertusa* (Reuss). These specimens differ from *S. terebrata* only in the possession on the basal portion

of elevations with knobby and lobular excrescences and proliferations. Schrammen regards such structures as probably only peculiarities of growth. This may be so, but in external form the specimens figured by Reuss (1845-1846, Pl. xvi, figs. 7, 8, 11-14) are in no way related to *S. terebrata* (Phillips); though similar in many respects to *S. turbinata* (Roemer). The illustrations of *Cnemidium pertusum* Reuss show either cylindrical or inverted top-shaped individuals, while the only one which has the stem partially shown displays the very abrupt contraction characteristic of Roemer's *S. turbinata*. It would perhaps be justifiable to make *Cnemidium pertusum* Reuss and all later references to this species synonyms of *Scytalia turbinata* (Roemer), but certainly the illustrations and descriptions available (including all protologs and protographs) do not justify the inclusion of *C. pertusum* under *S. terebrata* Phillips. According to Schrammen, the following species (to which I have added those listed by Frič and Pomel, since they were merely references based on the literature) are questionably included by Schrammen under *S. terebrata*; I would be inclined not to consider them even provisional synonyms.

- 1845-46, *Cnemidium pertusum* Reuss
- 1869, *Cnemidium pertusum* Frič
- 1872, *Calpia pertusa* Pomel
- 1878, *Scytalia pertusa* Zittel
- 1885, *Scytalia pertusa* Počta
- 1886, *Scytalia pertusa* Zahálka,

Similarly, if we accept the Schrammen revision, all identifications referring to A. Roemer's *Jerea turbinata* are likewise to be included in the synonymy of *Scytalia terebrata*. Thus:

- 1864, *Jerea turbinata* Roemer
- 1878, *Scytalia turbinata* Zittel
- 1889, *Scytalia turbinata* Griepenkerl

It seems to me, however, that Schrammen is not justified in considering *Scytalia turbinata* (Roemer) as a synonym of *S. terebrata* (Phillips). The data which he had at hand were Phillips' illustration of *Spongia terebrata*, Hinde's description of a specimen which he thinks must represent Phillips' species, Roemer's type of *Scytalia turbinata*, and the description and illustrations of specimens identified by Griepenkerl from the Upper Quadratenkreide of Glentorf, Braunschweig (Griepenkerl, 1888-1889, p. 18, Pl. II, figs. 4a, b). There is no reason to doubt that Griepenkerl's identification was correct, for his illustrations show forms in all outward respects similar to that figured by Roemer

(1864, p. 32, Pl. XII, fig. 1). There is in my mind, however, great doubt as to the identity of *S. terebrata* and *S. turbinata*, for the protograph of the first species shows a sponge which is decidedly tapering and neither "club-shaped" nor "cylindrical," as given by Schrammen in his description, while *S. turbinata* is thick and perfectly cylindrical, contracting abruptly into a comparatively slender cylindrical stem with a diameter only one-third as great as that of the upper portion. The description of *S. terebrata* given by Hinde is, in part, as follows:

Sponge massive, subcylindrical, with a flattened conical summit. The lower portion of the body contracts to a cylindrical stem. The lateral surface carries numerous concentric, slight, subangular ridges and shallow open furrows. The only specimen in the collection is 220 mm. in length by 87 mm. in greatest width. (Hinde, 1883, p. 45).

This description seems not to preclude entirely such a form as *S. turbinata* (Roemer), but Phillips' figure shows a tapering sponge gradually narrowing to a stem, while Roemer's illustration is of a form which was constricted abruptly. It is, of course, possible that the differences in form are of no significance and that all gradations between the tapering and cylindrical forms have been observed, for Schrammen in his description of *S. terebrata* says: "thick club-, top-, or thick cylinder-shaped." Yet, since neither Phillips, Hinde, nor any later author, Schrammen included, has figured the skeletal elements of *S. terebrata*, identifications must be made by such characteristics as form, size, and the measurements of various parts of the sponge. For these reasons, it seems to me that there is at least a strong element of doubt as to the wisdom of including *S. turbinata* (Roemer) and authors in the synonymy of *S. terebrata* Phillips.

If it should be true that *S. terebrata* and *S. turbinata* are distinct this would account for the great dissimilarity observable in the specimens labelled by Schrammen *S. terebrata*. A specimen from Oppeln, thus identified, has the characteristics of *S. turbinata* as figured and described by Roemer and as amplified by further description and illustrations by Griepenkerl. On the other hand, a specimen from Heere, identified by Schrammen as *S. terebrata*, fits in perfectly with the illustration of that species given by Phillips. Along with this specimen, however, is a second one which in form is very unlike the tapering, slender sponge figured by Phillips but is quite like *S. turbinata*. These two specimens had only one label and that bore the name *S. terebrata* (Phillips). In the higher horizon of the Quadratenkreide this same diversity of shape is seen in speci-

mens collected from Misburg, but whether or not Schrammen is wholly justified in considering all of these forms as belonging to one species is by no means certain.

18190. **Leptophragma glutinatum** (Quenstedt) (p. 236). TOPOTYPE

Quenstedt described this species as *Scyphia glutinata* (1878, p. 465, Pl. cxxxvii, figs. 9-12) from the Pläner of Oppeln. Leonhard placed it under the genus *Leptophragma* (1897, p. 34), including as a synonym the skeletal structure figured by F. Roemer in 1870 and called *Cribrospongia fragilis* (1870, p. 304, Pl. xxxi, figs. 2a, 2b). Schrammen does not agree with Leonhard in this, as may be seen by consulting the notes on *Callodictyon fragile* below (No. 18195). Schrammen (1910, p. 236) accepts Leonhard's general revision of the species, however, but states that he has searched for the species in vain in the northwest Germany equivalents of the Oppeln beds.

18191. **Ventriculites radiatus** (Mantell) (p. 265). PLESIOTYPE

This species was figured and described by Mantell in his 'Geology of Sussex' (1822, p. 168, Pls. x, xi, xii, xiii, xiv) from the Upper Chalk of England. Mantell clearly included several species under the one name and this has led to great confusion in the literature. In 1826 Goldfuss described *Scyphia oeynhausi* from the green chalk of Darup in Westphalia (1826, p. 219, Pl. lxxv, figs. 7a, b). At the end of the 'Petrefacta Germaniæ' Goldfuss put some corrections and additions, among which is the statement that Mantell's species *Ventriculites radiatus* is a synonym of *Scyphia oeynhausi* (p. 246), a statement which he incorporates in the body of the book in the second edition (1862, p. 204) where he gives no further recognition to Mantell's species. Since Goldfuss considered the forms which he described to be the same species as those described by Mantell, he was unwarranted in erecting a new specific name and in ignoring Mantell's claim to priority. The name proposed by Goldfuss must automatically be dropped and wherever later authors use the name *Scyphia oeynhausi* it must be changed to *Ventriculites radiatus* Mantell. This applies to A. Roemer's 'Kreidegebirge' (1841, p. 7) and von Zittel's 'Studien,' I (1877, p. 50). To be sure, Zittel has placed *Scyphia oeynhausi* Goldfuss in Mantell's genus *Ventriculites*, but he does not make any statement about the position of the species. A. Roemer's mistake in 1841 is plainly due to his acceptance of the statement made by Goldfuss in regard to the synonymy of Mantell's species with *Scyphia oeynhausi*.

In 1829 Phillips named and figured, though he did not describe, a species from the Chalk of Yorkshire as *Spongia cribrosa* (1829, p. 118, Pl. I, fig. 7). The specimen figured is evidently the stem of a *Ventriculites radiatus*, as may be seen by comparison with the illustrations given by Mantell (1829, p. 125 and on Pls. XII and XIII). Attention should here be called to the fact that A. Roemer (1841, p. 9) identified certain sponges from the Pläner of Goslar and Oppeln as *Scyphia cribrosa* Phillips and figured one of these (Pl. IV, fig. 2). The Roemer form is obviously different from that figured by Phillips and has been correctly assigned by Schrammen to Mantell's species *Ventriculites alcyonoides*, revised by Schrammen to *Leiostracosia alcyonoides* (q. v.).

D'Orbigny (1852, Terrains Crétacés, p. 284) erected the genus *Retispongia* with *Scyphia hoeninghausii* Goldfuss as the genoholotype. (The spelling *hoeninghausii* is incorrect; it should be *oeynhausi*). Fromentel followed D'Orbigny, except that he changed the generic spelling to fit in with his plan of nomenclature, calling the genus *Retiscyphia*, but both authors considered the Mantell species as distinct and called it *Ocellaria radiatus*.

A. Roemer in his 'Spongitarien des Norddeutschen Kreidegebirges' (1864, p. 15) accepted the generic revision given by D'Orbigny for *Ventriculites radiatus* and placed it under D'Orbigny's genus *Retispongia*, figuring a specimen from Germany. Roemer's illustration is the first in the literature which may be considered even a fair representation of the species. Roemer had by this time recognized Mantell's claim to priority and included in his synonymy *Scyphia oeynhausi* Goldfuss.

F. Roemer, in his 'Geologie von Oberschlesien,' accepted the D'Orbigny revision and cited *Retispongia radiata* (Mantell) from Oppeln and elsewhere.

Schlüter (1872, p. 30) considers the Goldfuss species distinct from Mantell's, since in the former (*oeynhausi*) he finds evidence of elongated, oval, radially and alternately placed postica, and longer meshes (occasionally an inch or more in length), whereas in *V. radiatus* Mantell the inner surface is covered with tubular postica. Schlüter comes to no conclusion as to the position of the genus *Retispongia*. He has found the species only in the Mucronatenkreide of Westphalia, while Hagenow thinks that he has found it also in Rügen. According to Zeuschner, it is found at Monoga near Krakau; according to Pagaard, also on the Island of Moen. Reuss and A. Roemer cite this species from the Pläner, but

this may be *Scyphia sulcata*, which species A. Roemer (1841, p. 10) does not refer to again in his later writings.

According to Schlüter, the true *V. radiatus* is found only in the Senonian, all of the forms from lower horizons being distinct.

In 1833 S. Woodward figured, but did not describe, from the Chalk of Norfolk, *Ventriculites infundibuliformis* (Pl. iv, figs. 20, 21). Hinde considers this a distinct species from *V. radiatus* Mantell, but Schrammen unites the two and, so far as one may judge from figures and descriptions, he is justified in considering the Woodward species and all later references to it as belonging to *V. radiatus* Mantell. Hinde, who had examined all of Mantell's and Smith's types, united under *V. infundibuliformis* the following species described by Smith: *V. bicomplicatus*, *V. latiplicatus*, *V. striatus*, "*V. radiatus* T. Smith (*non* Mantell)." Since Schrammen has included the *V. infundibuliformis* Woodward of Hinde in his synonymy of *V. radiatus* Mantell, then all of Smith's species given in the Hinde synonymy are to be included in the synonymy of *V. radiatus*. After studying the descriptions and figures of the four species of Smith's mentioned by Hinde, I am convinced that Schrammen followed the correct course in including these species under *V. radiatus*. The variety *V. radiatus discus* described by Quenstedt (1878, Pl. cxxxvi, fig. 26) and based upon Mantell's figure, Pl. xiv, in 'The Geology of Sussex' is considered by Schrammen a typical *V. radiatus*. Since the revision made by Schrammen has placed *V. striatus* Smith in the synonymy of *V. radiatus*, the two references to *V. striatus* made by Wollemaann in 1901 and 1902, being based directly upon the Smith description, are likewise to be included in *V. radiatus*.

In regard to Schrammen's revision of *Ventriculites radiatus* it may be stated that his synonymy is the most accurate that has yet appeared in the literature. Yet a revision based upon phylogenetic development would undoubtedly lead to the recognition of a large number of varieties and mutations. It might well be found that the species is polyphyletic and that there are included in it many forms which are end members of totally unrelated branches. Schrammen has pointed out that this is one of the best known and long-lived species of Cretaceous Hexactinellida; its geological range is from the Scaphiten-Turon through the Mucronaten-Senon. Schrammen has also called attention to certain morphological changes observable as one passes from the lower geological horizons to the higher. The oldest individuals, those occurring in the Scaphites Pläner, are the smallest and have the thinnest walls; but in the Senonian the walls become twice as thick or even thicker and there

is a corresponding increase in size. The general form of the sponge shows a constant type of variation at all horizons, the common shapes being funnel-like, discoidal or umbrella-shaped. For these morphological variants Quenstedt erected varietal names and Leonhard adopted the same nomenclature; but Schrammen quite rightly states that he cannot follow these authors in this. The ostia likewise show a definite trend in development, those in the oldest species being oval but those in the later ones displaying a marked tendency to form as long narrow slits. The postica similarly change from circular in the Turonian to more or less elongated oval in the Senonian, although, even in the Quadraten, forms with round postica are not of rare occurrence. These various differences in morphological characteristics at successive horizons have undoubtedly given rise to many of the specific names that have been introduced into the literature. While it is true that the *Ventriculites radiatus*, as now used by authors, does beyond doubt contain more than one species, the older method of making new species upon single morphological characteristics is of doubtful value. The only way of approach to the correct revision of the species will have to be through phylogenetic studies and these will be difficult to make because ontogenetic studies are almost impossible on account of the lack of preservation in sponges of the early ontogenetic stages. Since there are definite and recognizable morphological changes within the successive horizons, we have here an illustration of Waagen's mutations and a mutational name for the members of each horizon ought to be applied. Each of these mutations shows a series of variations in the Waagen sense, these variations being of the same kind in each mutation. Authors have previously classed together the corresponding variations of each mutation as constituting a distinct species, thus basing their classification on single characteristics which have evidently appeared through parallelism in development. The mutations show changes in form in the ostia and postica; the variations show changes in external form.

18192. *Ventriculites decurrens* T. Smith (Not in Schrammen Monograph).

This species was described by Toulmin Smith from the Chalk of England (1848, p. 215, Pl. XIII, fig. 8) and was later accepted by Hinde (1883, p. 111) who, however, included under it *V. decurrens* var. *tenuiplicatus* of T. Smith (1848, p. 215, Pl. XIII, fig. 9) and also *V. cavatus*, described by Smith from a fragment (1848, p. 212, Pl. XIII, fig. 5). Hinde considers that this species is probably the same as part of Mantel's *Ventriculites radiatus* (1822, Pl. XIII, fig. 4) and also a part of

Quenstedt's *V. radiatus* (1878, Pl. cxxxvi, fig. 23). In 1883, but before the appearance of the Hinde 'Catalogue,' Počta published his first 'Beiträge zur Kenntniss der Spongien der Böhmisches Kreideformation' in which he erected the variety name *Ventriculites radiatus* Mantell var. *subcylindrica* for that portion of Mantell's species figured by Quenstedt (1883, p. 33). He did not have a reference to Toulmin Smith's contributions. Hinde, on his part, makes no reference to Počta's paper but, if he is correct in considering that the specimen figured by Quenstedt as *V. radiatus* (1878, Pl. cxxxvii, fig. 23), is in reality the same as *V. decurrens* Smith, the latter constituting a stricter characterization of a part of Mantell's original comprehensive species *V. radiatus*, then Počta's varietal name *subcylindrica* has no standing.

In the discussion of *V. radiatus* we have already seen that Phillips' species, *Scyphia cribrosa*, is to be considered as *V. radiatus*. Yet Leonhard (1897, p. 33) placed *V. cribrus* (Phillips) as used by Počta (1886, p. 34) in his synonymy of *V. decurrens* Smith. Now Počta's use of *V. cribrus* is based upon the original figure given by Phillips in 1829, Pl. I, fig. 7, and he refers also to Hinde's *V. cribrus* (Phillips). Since *Scyphia cribrosa* Phillips is *Ventriculites radiatus* Mantell, sens. str., then the *Ventriculites cribrus* (Phillips), as used by Hinde 1883, Počta 1886, and Leonhard 1897, is to be considered *Ventriculites radiatus* (Phillips). Thus, Leonhard includes in his synonymy of *V. decurrens* T. Smith two references to *V. cribrus* which do not belong there and Počta in 1886 includes in his synonymy of *V. cribrus* Phillips the variety *V. radiatus* var. *subcylindrica* Počta, which is based upon Quenstedt's figure of *V. radiatus* and which had been revised to *V. decurrens* by Hinde. Počta, too, therefore, includes references of two distinct species in his synonymy of *V. cribrus*.

Schrammen does not refer in any way to *V. decurrens* in his Monograph, yet he has labelled two specimens from Oppeln and one from Grosse Heere by this name. He apparently overlooked the presence of these specimens in his collection and consequently did not describe the species in his book. The specimens have undoubtedly been correctly identified by Schrammen, for they agree with Smith's description and figure of this species.

An examination of all the original descriptions and figures of all the species involved in the present discussion has led me to the following conclusions.

Mantell in his description and figures of *Ventriculites radiatus* included at least two species: *V. radiatus*, sens. str., and *V. decurrens* T.

Smith. Hinde had access to the types of both Smith and Mantell and we may accept his restrictions and fuller definitions of the species. The particularly distinguishing characteristic of *V. radiatus* is the appearance on the outer surface of elongated, oval ostia about 3 to 5 mm. long and 1.5 to 2.5 mm. wide, according to Schrammen. The inner surface is covered with round or oval postica 2 to 4 mm. wide. The appearance of the outer surface is most frequently referred to by authors and it is this surface that is usually figured. *Ventriculites decurrens* Smith is a distinct species characterized by long ridges which are usually vertical, but at times oblique or bifurcating. *Spongia*, later *Scyphia cribrosa* Phillips, is a typical *Ventriculites radiatus* Mantell, so far as one may judge from the figure, since there is no description, and Schrammen so regards it. Počta's synonymy (1886, p. 34) is badly mixed up, for he includes under *Ventriculites cribrus* (Phillips) the following forms:

- 1829, *Spongia cribrosa* Phillips;
 1864, *Ventriculites multicosatus* Roemer;
 1883, *Ventriculites radiatus* var. *subcylindrica* Počta;
 1883, *Ventriculites cribrus* Hinde.

All of these species belong to *Ventriculites radiatus* (Mantell).

Leonhard's synonymy for *Ventriculites decurrens* Toulmin Smith stands, revised, as follows:

Leonhard, 1897	Revised Standing
1822, <i>Ventriculites radiatus</i> Mantell, Pl. XIII, fig. 4	<i>Ventriculites decurrens</i> T. Smith
1878, <i>Ventriculites radiatus</i> Mantell; Quenstedt, Pl. CXXXVI, fig. 23	<i>Ventriculites decurrens</i> T. Smith
1883, <i>Ventriculites decurrens</i> Smith; Hinde	<i>Ventriculites decurrens</i> T. Smith
1886, <i>Ventriculites cribrus</i> (Phillips) Počta	<i>Ventriculites radiatus</i> Mantell
1889, <i>Ventriculites cribrus</i> (Phillips) Frič	<i>Ventriculites radiatus</i> Mantell

18193. *Leiostracosia alcyonoides* (Mantell) (p. 284). PLESIOTYPES

See No. 18184.

18194. *Leiostracosia angustata* (A. Roemer) (p. 284). PLESIOTYPES

The history of the naming of this species has already been discussed under *L. alcyonoides* (see No. 18184). Roemer's species was described from the Pläner of Schonau near Teplitz, Bohemia (1841, p. 8, Pl. III, fig. 5). While Schrammen states that he has the types in his collection (1910, p. 284), it is highly improbable that he means the holotype, since

practically all of Roemer's types are now in the Roemer Museum at Hildesheim. There is no doubt, however, that Schrammen in making his revision of this species consulted the Roemer holotype, so that the specimens in the collection are plesiotypes.

18195. **Callodictyon fragile** (Roemer) (p. 289).

PLESIOTYPE

From the Pläner of Oppeln, A. Roemer described *Scyphia fragilis* (1841, p. 8, Pl. III, fig. 11) but later he assigned it to D'Orbigny's genus *Cribrospongia* (1864, p. 12), at that time giving the horizon more definitely as the Cuvieri Pläner. F. Roemer in his 'Geologie von Oberschlesien' speaks of the abundance of this species at Oppeln where it is usually preserved by iron oxide (1870, pp. 304, 305, Pl. xxxi, figs. 2, 2a, 2b).¹ Quenstedt figured specimens of this species from Oppeln (1876-1878, pp. 468-470, Pl. cxxxvii, figs. 14-16) calling them *Spongites fragilis*. In 1878 Zittel founded the genus *Leptophragma* including under it Roemer's *Scyphia fragilis* (1878, p. 48). This revision was accepted by Hinde (1883, p. 103), who records the species from the Upper Chalk of southern England. In 1884 Počta in his third paper on the 'Spongien der böhmischen Kreideformation' reported this species as abundant in the Teplitz beds of Bohemia in the neighborhood of Raudnitz, Tschischokovitz, Zidovitz, and Rohatce (1884, p. 34, Pl. I, fig. 26). Leonhard (1897, p. 33) simply listed the occurrences given by earlier authors without adding anything new, referring to the species as *Leptophragma fragile*.

Schrammen in his Monograph overlooked the Zittel revision, supposing that Leonhard had placed the species in the genus *Leptophragma* whereas Zittel himself had done so. Schrammen omitted the reference to Zittel in his synonymy so that it is made to appear as though Leonhard is responsible for assigning the species to the Zittel genus. Schrammen does not believe that it belongs to this genus and places it in *Callodictyon* Zittel on the basis of the skeletal elements (1910, p. 289).

18196. **Beckia nidiformis** (Leonhard) (p. 296).

PLESIOTYPE

This species was described by Leonhard as *Plocoscyphia nidiformis* (1897, p. 35, text figures 5a, b) from the Scaphites Pläner of Oppeln. At the same time he described *P. crassilobata* (1887, p. 35, Pl. III, fig. 62b) from the same horizon and locality. Schrammen (1912, p. 296) states that he has the types (*Belegestücke*) in his collection; but, while

¹Through an oversight on Roemer's part the figures of the illustration on Plate xxxi do not correspond with the ones used by him in the text. Anyone consulting this plate should therefore read or figures 3, 4, 5, figs. 2, 2a, 2b, which are the illustrations of *Cribrospongia fragilis*.

the inference would naturally be that he meant Leonhard's holotypes of *nidiformis* and *crassilobata*, such is not the case. All of Leonhard's types are in the collection of the Museum of the University of Breslau, so that Schrammen could only have been referring to his own specimens used in his further description of the species. After working out the specimens better, Schrammen came to the conclusion that Leonhard's two species are the same and that they belong not to the genus *Plocoscyphia* but to *Becksia* and constitute the oldest known representatives of the latter. Since the specimen in the American Museum Collection comes from the original locality and horizon from which the holotype was described, it is a plesiotype.

18197. *Plocoscyphia roemerii* Leonhard (p. 300).

PLESIOTYPE

See No. 18185.

Since Oppeln is the locality from which Roemer's material came, the specimen in the collection is a plesiotype of especial importance in making identifications.

18198. *Onchotæchus cavernosus* Schrammen (p. 309).

PARATYPE

From the Scaphites Pläner of Oppeln, Schrammen described *O. cavernosus* as a genoholotype (1910, p. 309, text figure 5). The specimen in the Museum Collection is almost identical with the figured holotype but, unfortunately, is only one of the paratypes of which Schrammen has examined fifteen.

18199. *Camerospongia monostoma* (A. Roemer) (p. 134).
= *Camerospongia fungiformis* F. Roemer (*non* Goldfuss).

PLESIOTYPE

In 1826-1833 Goldfuss (p. 218, Pl. LXV, figs. 4a, b, c) described *Scyphia fungiformis* from the green-gray chalk of Coesfeld, Westphalia. This form was recognized by A. Roemer in his 'Versteinerungen' (1841, p. 7) and at the same time he described a form as *Manon monostoma* from the Lower Cretaceous of Peine in Hanover and from Oppeln, Silesia, (1841, p. 2, Pl. I, fig. 8). Goldfuss' species was made the genoholotype of the genus *Camerospongia* by D'Orbigny in his 'Prodrome' (1850, II, p. 285), and he considered that *Manon monostoma* A. Roemer was a synonym of this; the characterization of the genus was very incomplete. Bronn in 1852 describes and figures *Scyphia fungiformis* ('Lethæa Geognostica,' 1852, part 5, p. 70, Pl. XXIX, fig. 6a, b, c). In his synonymy he includes *Scyphia fungiformis* Goldfuss, *Manon monostoma* A. Roemer and *Camerospongia fungiformis* (Goldfuss) D'Orbigny. E. de Fromentel in 1859 described and figured Goldfuss' species as *Camero-*

scyphia fungiformis (p. 41, Pl. II, fig. 16) but he did not include in his synonymy *Manon monostoma* A. Roemer. A. Roemer in 1864 again refers to (1864, p. 5) *Scyphia fungiformis* and *Manon monostoma* A. Roemer as *Camerospongia fungiformis*, citing the species previously figured by these authors. F. Roemer in his 'Geologie von Oberschlesien' (1870, p. 305) accepted his brother's synonymy which, in turn, was an acceptance of D'Orbigny's revisions.

Schrammen thinks that the species described and figured by F. Roemer as *Camerospongia fungiformis* is distinct from that originally described as *Scyphia fungiformis* by Goldfuss, but uses Goldfuss' specific name crediting it to F. Roemer. He includes here the species described by Quenstedt (1877, V, p. 499, Pl. cxxxix, figs. 2-6) as *Cephalites monostoma* and the species figured by Leonhard (1897, p. 36, Pl. III, fig. 3) as *Camerospongia fungiformis*. It is clear that the specific name cannot be credited to F. Roemer and, if Goldfuss' species is distinct, as held by Schrammen, the name *Camerospongia monostoma* (A. Roemer) must be ascribed to the species described by Schrammen. The species, according to A. Roemer, occurs in the Scaphites Pläner of Oppeln and at Heiningen in Braunschweig, also commonly in the Quadratenkreide of Ilsenburg, Eickhorst, Vordorf, and Peine. Goldfuss' original specimen is from the Mucronatenkreide of Coesfeld, while a related species described by Toulmin Smith as *Cephalites campanulatus* (1848, p. 289, Pl. xiv, figs. 12, 13) was obtained from the White Chalk of England. This F. Roemer considers as probably identical with the present form.

In conclusion, it may be stated that a study of the original descriptions and illustrations leads me to the belief that *Scyphia fungiformis* Goldfuss and *Manon monostoma* A. Roemer were undoubtedly distinct species, for Goldfuss speaks especially of his species having a stem and appearing like a mushroom, while A. Roemer, who originally recognized the Goldfuss species as distinct from his *M. monostoma*, though he later united the two, does not in describing the latter make any reference to the presence of a stem. The uniting of the two species as one has undoubtedly been done by authors because the Roemer illustration shows a form which looks like the top of Goldfuss' species, a form which might result were a mushroom-like individual deprived of its stem.

18200. *Camerospongia fungiformis* (Goldfuss).

In the Schrammen Collection purchased in 1903 there is a very good specimen labelled "*Camerospongia fungiformis* Goldfuss sp." All of the enclosing limestone has been worked away so that the form and surface

features of the sponge and the characteristics of the stem may be seen. This specimen, if any, approaches the species described by Goldfuss and if we rely upon Schrammen's label we have here a representative of the true *C. fungiformis*. The species is not described by Schrammen in his Monograph, probably because he had sent to America his only representative of the species many years before he wrote his book, although this is only an assumption. The specimen is not a type but is included because it is of use in the determination of the perplexing problem of the identity or distinctness of *Camerospongia monostoma* A. Roemer and *C. fungiformis* (Goldfuss).

18201. **Cameroptychium patella** Leonhard (p. 320).

PLESIOTYPE

This species was described from a single specimen from the Scaphites Pläner of Oppeln (Leonhard, 1897, p. 37, Pl. iv, figs. 2a, b, c, d). Schrammen found this specimen and gave it to Leonhard to describe so that it became the holotype. Subsequently Schrammen found two more specimens and was able to add some data to the original description (1910, p. 320). Although Schrammen states that he has the types in his collection one must bear in mind that he has only the two plesiotypes, not the original holotype which is in the Mineralogical Museum of the University of Breslau according to Leonhard's statement (see 1897, *Erklärung für Tafel IV*). Schrammen also regards Leonhard's *Plocoscyphia tenuilobata* (1897, p. 36, Pl. iv, figs. 1a, b) as a specimen of this species partly modified in preparation.

SPECIES FROM NETTLINGEN, HANOVER

18202. **Doryderma (Homalodora) plana** Schrammen (p. 59).

IDIOTYPE

Schrammen described this species from the Quadratenkreide and Mucronatenkreide of Misberg and Oberg (1910, p. 59, Pl. xvii, figs. 3, 4), the figured cotypes being from the Quadratenkreide of Oberg. He appears to have overlooked the specimen from the lower horizon at Nettlingen, so that the individual in the collection is an idio-type.

18203. **Amphilectella piriformis** Schrammen (p. 61).

IDIOTYPE

This is the genoholotype of, and sole species in, the genus *Amphilectella* described by Schrammen in 1901 (p. 13, Pl. iii, fig. 3) from the Quadratenkreide and Mucronatenkreide. The figured holotype is from the Mucronaten of Misberg and is now in the Roemer Museum. In the Monograph, Schrammen figured a specimen from the Quadratenkreide of Oberg (1910, Pl. xviii, fig. 8; skeletal elements, text plate II, fig. 6)

and more fully described the species. As in the case of the preceding species he failed to record the occurrence from the lower horizon at Nettlingen although he himself had labelled the specimen.

18204. ***Pachinion scriptum*** (Roemer) (p. 67).

PLESIOTYPE

Roemer described this species as *Jerea scripta* (1864, p. 34, Pl. XIII, fig. 4), recording it from the Mucronatenkreide of Tadensen not far from Duddensstedt. Hinde ('Catalogue,' 1883, p. 46, Pl. VII, fig. 1) has found it in the Upper Chalk of Flamborough and in the south of England. He also notes that in Zittel's collection are specimens from Schwiechelt. The species was further described by Zittel (1878, II, p. 130), but its range was not extended. Schrammen, however, records it from as low as the Scaphites beds and from Nettlingen, Heere, Misburg, Oberg, Adenstedt, and Biewende (1910, p. 67, Pl. XVIII, fig. 4, Pl. XIX, fig. 1; skeletal elements, text plate III, fig. 1). Since Schrammen amplified Roemer's original description, the specimens identified by him are plesiotypes.

18205. ***Phalangium cylindratum*** Schrammen (p. 70).

IDIOTYPE

This is a species described and figured by Schrammen from the Cuvieri beds of Heere where he has collected five specimens (1910, p. 70, Pl. XVIII, fig. 2). He does not record its presence at any lower horizon nor at Nettlingen, yet he has labelled a large specimen therefrom. It appears to be a case of oversight. The specimen probably is an idiotype; it is hardly likely that it is a cotype, for if Schrammen had used it in making his description he would surely have recorded its presence.

18206. ***Phymatella intumescens*** (Roemer) (p. 73).

PLESIOTYPE

This species, occurring in the lower Senonian horizons, the Scaphites and Cuvieri beds, is regarded by Schrammen merely as an older mutation of *Phymatella tuberosa* (Quenstedt) and *P. bulbosa* Zittel which have undergone certain morphological changes, the latter perhaps in response to a changing environment. *P. intumescens* was described as *Eudea intumescens* by Roemer (1864, p. 26, Pl. XI, fig. 1) who records it as abundant in the Cuvieri beds of Windmühlenberg near Salzgitter, at Dörnton and in the Quadraten limestone in the Köhlerholze near Ilsenberg. Roemer considers that his species may be identical with Michelin's *Eudea (Scyphia) trilobata*. The specimen in the collection is the oldest known mutation of the species.

In 1878 Quenstedt described *Spongites plicatus* (1878, p. 395, Pl. cxxxiv, figs. 1-2) from the Pläner of Oppeln. This species Schrammen states, is synonymous with *Phymatella intumescens* (Roemer), for he has collected an abundance of the forms corresponding to Quenstedt's figures and description and has compared them with the Roemer types. On the strength of this revision all species referred by later authors to *Spongites plicatus* (Quenstedt) must be called *Phymatella intumescens* (Roemer).

In the second part of the Zittel 'Studien' the name *Phymatella* is erected to include parts of a large number of genera (1878, p. 138) and under this new genus the author includes among others *Eudea intumescens* A. Roemer and *Spongites plicatus* Quenstedt, but he does not unite them both under the one species as does Schrammen.

Počta has identified specimens from the Weissenberg beds of Leneschitz near Laun, Bohemia, as *Phymatella plicata* (Quenstedt) (1884, p. 32). This is to be referred to *P. intumescens* (Roemer). The same may be said for the reference by Leonhard (1897, p. 38) to *Phymatella plicata* (Quenstedt).

18207. ***Phymatella bulbosa*** Zittel (p. 75).

Until the discovery by Schrammen of a specimen from Nettlingen, this species described by Zittel in 1878 ('Studien,' II, p. 138) was known only from the higher Senonian, the Quadraten and Mucronatenkreide. Schrammen succeeded in finding a considerable number of specimens not only from these horizons, but he also found at least one specimen at Nettlingen in the Cuvieri beds, for he has labelled it and with a full appreciation of its importance, for he calls it the oldest mutation of the species. But he overlooked its presence in his collection apparently, for in his Monograph he does not record this species either from the Cuvieri horizon or from Nettlingen.

Schrammen in 1901 erected the genus *Pseudoplosocyphia* with *P. mæandrina* as the genoholotype and sole species (1901, p. 4, Pl. II, fig. 1; skeletal elements, Pl. IV, fig. 2). The species at that time was known to him only from the Mucronatenkreide of Misburg; the holotype of the genoholotype is in the Roemer Museum. In his Monograph Schrammen includes this species under *Phymatella bulbosa*, so that the genus *Pseudoplosocyphia* becomes a *nomen nudum*.

18208. ***Phymatella* aff. *tuberosa*** (Quenstedt) (p. 176).

See No. 18298 for discussion of this species.

This species is reported by Schrammen only from the Quadratenkreide and Mucronatenkreide and from Misburg, Oberg, and Ilsenburg. He appears to have overlooked the specimen from the Scaphites Pläner of Nettlingen, which is, however, identified only as a form related to *P. tuberosa*.

18209. **Thecosiphonia torgeri** Schrammen (p. 83).

COTYPE

See No. 18181.

18210. **Siphonia tubulosa** (Roemer) (p. 93).

HOMŒOTYPE

A. Roemer described this species as *Scyphia tubulosa* from the Lower Cretaceous of Peine (1841, p. 8, Pl. III, fig. 10). The description is meagre; the illustration schematic and, as Schrammen points out, the Roemer holotype was figured standing on its head. Schrammen has supplemented the original description (1910, p. 93) and has figured three specimens from the Quadratenkreide of Oberg (Pl. II, figs. 6-8; skeletal elements, text plate IV, fig. 11). Griepenkerl described as *Siphonia ovalis* an abundant form from the Quadratenkreide of Glentorf in Braunschweig (1888-1889, p. 20, Pl. III, figs. 3a, b). This Schrammen refers to *S. tubulosa* (Roemer). The occurrences cited by Schrammen are from Misburg, Oberg, Adenstedt and Glentorf, and he mentions no lower horizon than the Greensand of the Quadratenkreide. Thus he has again overlooked the specimen from the Scaphites Pläner of Nettlingen now in the Museum.

18211. **Pholidocladia dichotoma** Hinde (p. 108).

PLESIOTYPE

This species is one of the two genosyntypes of Hinde's *Pholidocladia* and was described from the Upper Chalk of Wiltshire, the figured holotype being now in the Jermyn-Street Museum, London (Hinde, 1883, p. 81, Pl. XX, figs. 5, 5a, 5b). Schrammen has found a few specimens in the Scaphites Pläner of Nettlingen and in the Kalkmergel of the Quadratenkreide of Oberg (1910, p. 108, Pl. IV, fig. 2; skeletal elements, text plate VI, fig. 3).

18212. **Isoraphinia texta** (Roemer) (p. 129).

PLESIOTYPE

Roemer described this species as *Siphonocelia texta* (1864, p. 29, Pl. X, fig. 11) from the Cuvierkreide of Vorberg near Haverlah. Quenstedt called this species *Eulespongia texta* and gave good illustrations of specimens from Haverlah, Sehle, and Steinlah (1876-1878, Pl. CXXXV, figs. 3-7). It was Roemer's species which Zittel made the genoholotype of *Isoraphinia* (1878c, p. 133, Pl. V, fig. 8, Pl. VII, fig. 3).

In the synonymy are to be included *Isoraphinia texta* (Roemer) Hinde (1883, p. 55, Pl. x, figs. 3, 3a, 3b) from Flamborough, Yorkshire, and *I. texta* (Roemer) Zahálka (1886, p. 647, Pl. i, figs. 1, 2) from the Teplitz beds of the southern border of the Rohatetz hill in Bohemia.

Schrammen has also placed in his synonymy *Jerea spiculigera* described by Roemer in 1864 (p. 34, Pl. xii, fig. 6) from the Cuvierkreide of Windmühlenberg near Salzgitter, for he thinks that the form in all probability is only the stem of an *I. texta*. This being the case, Zittel's *Carterella spiculigera* (1878c, p. 133, Pl. vii, fig. 2) must also be included in the *I. texta* synonymy.

Schrammen gives the range of this species as from the Scaphites through the Cuvier Pläner and he records its occurrence at Nettlingen, Heere, and Salder.

18213. ***Pachycothion giganteum*** (Roemer) (p. 130).

PLESIOTYPE

See No. 18183.

18214. ***Halichondria vosmæri*** Schrammen (p. 131).

PARATYPE

There is in the collection a specimen from the Scaphites beds of Nettlingen labelled *Halichondria lendenfeldi*. Since Schrammen has described in his Monograph only a single species of the genus *Halichondria*, namely, *H. vosmæri*, it would appear that the specimen in the American Museum is a chirotype. However, it agrees perfectly with the illustrations and descriptions of *H. lendenfeldi*; furthermore, the descriptive headings for the illustrations both appear under the name *H. lendenfeldi* (Schrammen, 1910-1912, Pl. xiii, fig. 2 and text plate viii, fig. 10), although in the body of the text the species is called *H. vosmæri* with the plate references above given immediately following. Apparently Schrammen labelled some of his specimens of this species *H. lendenfeldi* and others *H. vosmæri* and through an oversight the illustrations bear the name of *H. lendenfeldi* while the species appears in the text as *H. vosmæri*. It may have been that the name *lendenfeldi* was used at first for all of the specimens, since Schrammen had only five, and that at a later time he found it necessary to change the name and simply failed to change all the labels and to correct all of the places where *lendenfeldi* occurred in his manuscript. There is no way of telling which name had priority in Schrammen's own work, but I have accepted the name of *H. vosmæri* as the one to stand because the description of the species was given under that designation. The specific name *lendenfeldi* becomes a synonym of *vosmæri*.

18215. *Rhizopsis horrida* Schrammen (p. 132).

PARATYPES

To certain peculiarly shaped sponges in the Scaphites Pläner of Nettlingen and the Quadratenkreide of Oberg, Schrammen has given the name *Rhizopsis horrida* (1910, p. 132). The species is the genoholotype and, so far, the sole species in the genus. A single specimen from the Scaphites Pläner of Nettlingen was figured by Schrammen (*loc. cit.*, Pl. XIII, fig. 4), while the skeletal elements come from the Quadratenkreide of Oberg (text plate VIII, fig. 11). Since there is a possibility that the skeletal elements may not have been correctly identified, the complete specimen must be considered the holotype and Nettlingen the type locality.

18216. *Opetionella poculum* Schrammen (p. 134).

METATYPE

Schrammen in describing this species from the Scaphites Pläner of Nettlingen states (1910, p. 134) that he has only a single specimen and this he has figured (Pl. XIII, fig. 3). He sent to the Museum a specimen which he designated as a type, but on comparison with the protograph the specimen is seen not to agree with it nor yet with the dimensions which are recorded in the text. Assuming that the identification of the specimen which Schrammen sent is correct, then he must have overlooked this specimen, which is only a metatype, since no use is made of it in his protolog.

18217. *Verruculina tenuis* (Roemer) (p. 136).

PLESIOTYPES

From the Lower Chalk of Oppeln, Roemer described *Manon tenue* (1841, p. 3, Pl. I, fig. 7) which he later called *Chenendopora tenuis* (1864, p. 43, Pl. xv, fig. 4), although in giving the horizons in his second paper he speaks only of the Cuvierikreide of Salzgitter and Gr. Döhren and the Scaphitenmergel of Heiningen. His brother, F. Roemer, followed him in this designation (1870, p. 301, Pl. xxxi, figs. 6, 7, 8, [non fig. 1 according to Schrammen]) as did also Quenstedt (1866-1868, p. 324; Pl. cxxxI, fig. 8; Pl. cxxxII, figs. 46-48).

Zittel placed the species in his genus *Amphithelion* (1878c, p. 124) and this revision was accepted by the following authors: Počta (1884, p. 23), Leonhard (1897, p. 37), Schrammen (1901, p. 21).

Hinde, supposing that *Manon tenue* and *Chenendopora tenuis* were distinct species, because Roemer himself does not include the first in the synonymy of the second and the horizons and localities for the two are different, and also because he thought that both belonged to the genus

Verruculina, stated that Roemer's original type should be called by the specific name *tenuis*, but that for the species described by Roemer in 1864 another name would have to be proposed and so for the English species from the Upper Chalk of Flamborough, Yorkshire, he proposed the name *Verruculina pustulosa* (1883, p. 39, Pl. III, figs. 2, 2a) and included in his synonymy:

1845, *Manon miliare* Reuss, *pars* (p. 78, Pl. XIX, fig. 13)

1864, *Chenendopora tenuis* F. A. Roemer, *pars* Pl. XIII, fig. 4

non Manon tenue F. A. Roemer, 1841, Pl. I, fig. 7.

Schrammen, who had the advantage of being able to study all of the Roemer types, and who had himself collected both from the Oppeln and the northwest German horizons, explains that Roemer's *Manon tenue* 1841 and *Chenendopora tenuis* 1864 are the same species and for this reason he includes both of them and also Hinde's *Verruculina pustulosa* and *Manon miliare* Reuss in his synonymy of *V. tenuis*.

While Hinde, Pošta and Leonhard hold that *Manon tenue* Reuss (1845-1846, p. 78, Pl. xx, fig. 2) are synonyms of *V. tenuis* Roemer, Schrammen does not agree with them and considers rather that the fragment figured by Reuss as *Manon miliare* (1845-1846, p. 78, Pl. XIX, fig. 13) belongs to *V. tenuis* Roemer (Schrammen, 1910, p. 137).

The species ranges from the Scaphites Pläner through the Mucronatenkreide and occurs at Oppeln, Nettlingen, Heere, Sudmerberg, Misburg, Oberg, Biewende.

18218. *Verruculina damæcornis* (Roemer) (p. 137).

PLESIOTYPES

This species was described by Roemer as *Verrucospongia damæcornis* (1864, p. 45, Pl. XVI, fig. 5) from the Cuvierkreide of Windmühlberg near Salzgitter, and was included by Zittel under his genus *Amphithelion* (1878c, p. 124). Schrammen reports its further occurrence in the Scaphites Pläner of Nettlingen.

18219. *Verruculina convoluta* (Quenstedt) (p. 138).

PLESIOTYPES

Phillips figured and named a specimen from the White Chalk of Danes' Dike, Yorkshire, as *Spongia convoluta* (1829, p. 118, Pl. I, fig. 6) and he later changed the name to *Chenendopora convoluta* (1875, p. 234, Pl. I, fig. 6). The figures in both cases are poor, and Hinde says that it is impossible to be sure which of a number of species represented in the Chalk of Yorkshire was intended by Phillips when he gave the name (1883, p. 38).

Quenstedt had already called attention to the fact that the Phillips' illustration was poor and he figured from the Upper Pläner of Dörnten, south of Salzgitter, specimens which he considered as apparently belonging under Phillips' "appropriate name" *Spongia convoluta* (Quenstedt, 1878, p. 369, Pl. cxxxii, figs. 49, 50, 51).

In 1841 A. Roemer described from the Lower Kreide of Oppeln *Manon tenue* (1841, p. 3, Pl. i, fig. 7), the name of which he later changed to *Chenendopora tenuis* (1864, p. 43, Pl. xv, fig. 4) recording it further from the Cuvierikreide of Salzgitter and at Osterkopfe near Gr. Dörnten as well as in the Scaphitenmergel of Heiningen. The illustrations are very poor, the figure in 1841 being of almost no value. F. Roemer cites *Chenendopora tenuis* A. Roemer from the Turonian Pläner of Oppeln and gives excellent illustrations (1870, p. 301, Pl. xxxi, figs. 1, 1a).¹ It is not at all certain, however, that the figures given by F. Roemer are illustrations of his brother's type and a comparison of the figures and descriptions given by the two authors leads one rather to the conclusion that the two species are distinct. Furthermore, since F. Roemer included under his *C. tenuis* two different species, the identity of the form is difficult to determine and authors have followed Hinde in considering part of F. Roemer's *Chenendopora tenuis* as a synonym of Quenstedt's species *Verruculina convoluta*.

Zittel placed *Spongia convoluta* Quenstedt in his genus *Amphithelion* (1878c, p. 124) which, by both Hinde and Schrammen, has been considered a synonym of *Verruculina* Zittel.

Schrammen records the species from Nettlingen, Oppeln, Dörnten, Misburg, and Oberg and gives the range as from the Scaphites Pläner through the Mucronatenkreide.

18220. *Verruculina crassa* (Roemer) (p. 138).

PLESIOTYPES

This species was described as *Chenendopora crassa* by A. Roemer (1864, p. 43, Pl. xvi, fig. 1) from the Cuvierikreide of Kahnstein. Schrammen unites with Roemer's species, *Manon circumporosum* of Quenstedt described from the Middle Pläner of Gustedt north of Salzgitter (1878, p. 372, Pl. cxxxii, fig. 55). Since Zittel considered that both of these species belonged to his genus *Amphithelion*, there must be included in the synonymy of *Verruculina crassa*, *Amphithelion circumporosum* and *A. crassa* as given by Zittel (1878c, p. 124). As is usually

¹On the same plate he gives figures of a specimen which he calls *C. tenuis* (Pl. xxxi, figs. 6, 7, 8), but these are of another species.

the case, the illustration given by Roemer is very poor, that by Quenstedt good. The two specimens in the collection are quite as perfect as that figured by Quenstedt (*loc. cit.*).

18221. ***Stichophyma verrucosa*** (Roemer) (p. 143).

PLESIOTYPES

This species was called *Polyjerea verrucosa* by Roemer (1864, p. 35, Pl. XIII, fig. 5) and was referred by Zittel to *Stichophyma verrucosa* (1878c, p. 125). Reuss in 1845-1846 described *Manon turbinatum* (p. 78, Pl. XIX, figs. 1-6) from the lowest Plänerkalk of Schillinge near Bilin, Bohemia. This latter combination of generic and specific names had been preoccupied by Roemer (1841, p. 3, Pl. I, fig. 5) for another species now recognized as *Stichophyma turbinata* (Roemer). Počta (1884, p. 25) referred the Bohemian species of Reuss to *Stichophyma: S. turbinata* (Reuss) Počta. Reuss had described *Manon sparsum* (1845-1846, p. 78, Pl. XVIII, figs. 12-20) which was referred to in 1884 by Počta (p. 26) as *Stichophyma sparsa* and this form is now considered by Schrammen as the young of *S. turbinata* (Reuss), not *S. turbinata* (Roemer). Schrammen, on account of the lack of Bohemian material for comparison, was unable to determine whether *Manon* (*Stichophyma*) *turbinatum* (Reuss) and *Polyjerea* (*Stichophyma*) *verrucosa* (Roemer) were identical, but he considers that *S. turbinata* Reuss is undoubtedly closer to *S. verrucosa* (Roemer) than is the *S. turbinata* of (Roemer). Should the Bohemian and the northwest German species prove identical, then the name *S. sparsum* (Reuss) has priority, provided, of course, that it is the young of *Manon* (*S.*) *turbinatum* (Reuss). It is probably wise to use Roemer's name (*S. verrucosa*) for this species, even though *Manon turbinatum* Reuss (*Stichophyma turbinata* Počta) prove, on further study, to be identical with *Polyjerea* (*Stichophyma*) *verrucosa* Roemer, since it would very likely be impossible to show that *M. sparsum* Reuss is really the young of *M. turbinatum* Reuss. As above stated, *turbinatum* cannot be used for this species, since that name was preoccupied by Roemer in 1841 for another species of the same genus.

18222. ***Stachyspongia ramosa*** (Quenstedt) (p. 148).

PLESIOTYPES

This species was described as *Spongia ramosa* by Quenstedt (1878, pp. 309, 400, Pl. CXXXIV, figs. 7, 8) from the Middle Pläner of Gustedt and the Upper Pläner of Dörnten. It occurs abundantly in the Scaphites beds of Nettlingen from which Schrammen has examined about 50 specimens (Schrammen 1910, p. 148).

18222a. is a young individual.

18223. **Chonella auriformis** (Roemer) (p. 161).

PLESIOTYPES

This species was described as *Achilleum auriforme* by A. Roemer (1841, p. 2, Pl. I, fig. 3) from the Lower Kreide of Peine and the Lower Kreidemergel of Ilseburg. The illustration is very unsatisfactory, but it shows the characteristic shape of the species. Roemer mentions it again in his later work without further illustrating or describing it, and he there places it in D'Orbigny's genus *Cupulospongia* (1864, p. 51). Zittel included this species in his genus *Chonella* and figured the skeletal elements (1878c, p. 116, Pl. III, figs. 6, 7). This revision is accepted by Schrammen who, in his Monograph, gives the first satisfactory illustrations which have appeared in the literature (1910, p. 161, Pl. XIX, figs. 3, 4), the specimens figured coming from the Scaphites Pläner of Nettlingen. Schrammen also records the species from the Lower Senonian Sandmergel of Sudmerberg and from the Kalkmergel of the Mucronatenkreide of Misburg.

18224. **Seliscothon planum** (Phillips) Hinde (p. 163).

PLESIOTYPES

This was described by Phillips in the first edition of the 'Geology of Yorkshire' as *Spongia plana* (1829, p. 177, Pl. I, fig. 1). Hinde, having access to the types figured by Phillips, places *Spongia plana* and *Spongia capitata* both under Zittel's genus *Seliscothon* and calls them *Seliscothon planus*. He says: "As no description whatever accompanies the figures of the sponges from the Flamborough Chalk given by Phillips in the 'Geology of Yorkshire,' and as the figures are very imperfectly drawn, it is often a matter of great difficulty to determine the forms which they are supposed to represent" ('Catalogue,' p. 32). He adds that while the figures given by Phillips of *Spongia capitata* and *Spongia plana* seem to be of distinct species, in reality the only difference consists in the outer form, the summit of *S. capitata* not having been developed to the same extent as that of *S. plana*. In the British Museum are specimens showing a complete gradation from the one "species" to the other. Schrammen corroborates Hinde's classification and likewise includes, under *Seliscothon planum*, *Spongia capitata* Phillips (Phillips, 1829, p. 177, Pl. I, fig. 2) on the ground that it represents only the young of the former and not a distinct species. He further includes under this species *Chenendopora explanata* Roemer (1864, p. 44, Pl. XIV, fig. 3), described from the Mucronatenkreide of Ahlten, and *Seliscothon planum*, *explanatum*, and *capitatum* listed as separate species by Zittel (1878c, pp. 117, 118). The species in Germany ranges through all the horizons

of the Upper Cretaceous and has been found at Nettlingen, Salder, Heere, Misburg, Oberg, Adenstedt, and Biewende (Schrammen, 1910, p. 164).

18225. *Craticularia maaki* Schrammen (p. 233).

CHIBOTYPE

This species is represented by two fragments of the wall, there being a small piece and a larger one, the latter measuring 3.5 cm. in width by 3.2 cm. in height. The outer surface is covered with round ostia arranged in parallel vertical and horizontal rows. The aporhyza open on the inner surface in oval postica showing a linear arrangement similar to that characterizing the ostia. This species is similar to *C. relictæ* Schrammen, but smaller. The thickness of the wall is only 5 mm. in *C. maaki*, but 8 mm. in *C. relictæ*. In the latter there are sixteen ostia and postica to the square centimeter, in *C. maaki* there are thirty-six. The two new species of *Craticularia* described by Schrammen are from the Quaternary, whereas *C. maaki* is from the Scaphites Pläner of Nettlingen.

18226. *Guettardia striata* Schrammen (p. 241).

IDIOTYPES

This species was described by Schrammen (1910, p. 241, Pl. XXX, figs. 6, 7, 8, text plate IX, fig. 5) from the second, third, and fourth zones of the Senonian at Gleidingen, Misburg, and Oberg, but he does not record it from so low an horizon as the Scaphites beds, nor from Nettlingen. The two specimens in the collection are undoubtedly from Nettlingen and they are labelled by Schrammen himself. They are, therefore, idiotypes.

18227. *Botryosella labyrinthica* Schrammen (p. 259).

IDIOTYPE

From the Cuvieri Pläner of Grosse Heere, Schrammen described this species which is founded upon two specimens, one of which is figured (1910, p. 259, text fig. 3; skeletal elements, text plate IX, fig. 3). The species is the genoholotype of Schrammen's *Botryosella* which is monotypic. Since Schrammen did not note the occurrence of this species at Nettlingen, though he himself had written the label, the specimen in the American Museum Collection is in idiomorph.

18228. *Ventriculites radiatus* Mantell (p. 265).

PLESIOTYPE

See No. 18191 for full notes on the species. The specimen from Nettlingen and the one from Oppeln are the oldest known mutations of this species.

18229. *Leiostracosia alcyonoides* (Mantell) (p. 284).

See No. 18184.

18230. *Leiostracosia angustata* (Roemer) (p. 284).

HOMŒOTYPE

See No. 18194.

18231. *Becksia nidiformis* (Leonhard) (p. 296).

HOMŒOTYPE

In the 1914 collection obtained from Schrammen there was no representative of this species, but in the 1903 collection there was a single specimen. Since Schrammen had examined all of Leonhard's types in the Museum of the University of Göttingen, the specimen identified by Schrammen as *Becksia nidiformis* is a homœotype. For further notes on the synonymy see No. 18196.

18232. *Plocoscyphia roemeri* Leonard (p. 300).

PLESIOTYPE

See No. 18185.

18233. *Plectascus clathratus* (Roemer) (p. 308).

PLESIOTYPE

See No. 18186.

The Cuvieri Pläner (Zone 5 of Strombeck)

SPECIES FROM SALDER, HANOVER

18234. *Thecosiphonia nobilis* (Roemer) (p. 84).

PLESIOTYPES

See No. 18188.

18235. *Isoraphinia texta* (Roemer) (p. 129).

PLESIOTYPE

See No. 18212.

SPECIES FROM GROSSE HEERE, HANOVER

18236. *Procorallistes polymorphus* Schrammen (p. 69). HEAUTOTYPES

Schrammen described this species in 1901 from the higher Senonian of Oberg and Misburg (1901, p. 15), the figured holotype coming from the Quadratenkreide of Oberg (*loc. cit.*, Pl. I, fig. 10) and being now in the Roemer Museum. At the same time Schrammen described *P. tuberosus* from the Quadratenkreide of Oberg, the two constituting the genosyntypes for his *Procorallistes* (1901, p. 15, Pl. I, fig. 11); the holotype of the second species is likewise in the Roemer Museum. In his Monograph, Schrammen states that he considers *P. tuberosus* only a young stage of *P. polymorphus* and thus the genus is left with only a single species (1910, p. 69, Pl. xx, figs. 1, 2; skeletal elements, text plate III,

fig. 3). Since Schrammen in the protolog recorded the species from Oberg and Misburg and only subsequently in his Monograph noted it from Grosse Heere, the specimens in the collection are heautotypes. One of the two specimens shows this species and *Phalangium scytaliforme* growing together.

18237. *Procorallistes turonensis* Schrammen.

CHIROTYPE

In the 1903 collection is a specimen labelled *Procorallistes turonensis*. It is identical in all outward respects with a specimen in the 1914 collection labelled *P. polymorphus*. It seems highly probable that the two are the same species and that Schrammen used the specific name *turonensis* as a manuscript name only—for it appears nowhere in print—and that when he described the new species *polymorphus* for the Monograph he forgot that he had used *turonensis* at an earlier time. As it is at present impossible to determine with certainty whether the two specimens do belong to the same species, we may retain the earlier name as a chironym.

The specimen of *P. turonensis* is auriforme and shows the stem. It is 11 cm. high and the stem, which is broken off, is 2 cm. in diameter.

18238. *Phalangium scytaliforme* (Schrammen) (p. 70).

IDIOTYPES

This is one of two genosyntypes for Schrammen's genus *Phalangium* founded in 1910 (p. 69). *P. scytaliforme* was described from the Kalkmergel of the Mucronatenkreide of Misburg whence the figured holotype came (*loc. cit.*, Pl. XVIII, fig. 1; skeletal elements, text plate III, fig. 2) and whence Schrammen examined ten specimens. Of any occurrences at lower horizons or other localities he makes no mention, so that the four specimens in the collection, which were apparently overlooked by the author when he wrote his Monograph, constitute significant idiotypes

18239. *Phymatella intumescens* (Roemer) (p. 73).

PLESIOTYPES

See No. 18206.

18240. *Phymatella* aff. *bulbosa* von Zittel mut. *postera* Schrammen

CHIROTYPE

For notes on *P. bulbosa* see No. 18207. Schrammen does not list this species from any lower horizon than the Quadratenkreide, but this specimen labelled by him mut. *postera* shows that a specimen at least related to *bulbosa* occurs as low as the Cuvierikreide.

18241. *Phymatella sphæroides* Schrammen (p. 76). IDIOTYPE

As is the case with so many of the specimens from Grosse Heere, which were described by Schrammen from higher horizons and were not recorded from the Cuvieri Pläner, the specimen of the present species becomes for the same reason an idiotype. The species is described from the Kalkmergel of the Quadratenkreide and Mucronatenkreide of Oberg and Misburg, the figured cotypes coming from the Quadratenkreide of Oberg (1910, p. 77, Pl. II, figs. 6-8).

18242. *Isoraphinia texta* (Roemer) (p. 129). PLESIOTYPES

See No. 18212.

18243. *Verruculina tenuis* (Roemer) (p. 136). PLESIOTYPES

See No. 18217.

18244. *Verruculina convoluta* (Quenstendts) (p. 138).

See No. 18219.

18245. *Verruculina crassa* (Roemer) (p. 138). PLESIOTYPE

See No. 18220.

18246. *Scytalia terebrata* (Phillips) (p. 150). PLESIOTYPE

See No. 18189.

18247. *Scytalia laevis* Schrammen. CHIOTYPE

In the 1903 collection is a fairly complete specimen labelled *Scytalia laevis*. It is 15 cm. in length, and 3.5 cm. in greatest diameter. It is cylindrical and shows about 2.5 cm. of the stem which is broken off. The form and depth of the paragaster are unfortunately not shown. The specimen agrees with the description of *Scytalia radiciformis* (Phillips) in all outer characteristics and shows especially well the annular thickenings. Until studies are made of the skeletal elements, however, it would be unwise to include *S. laevis* in any previously described species.

18248. *Cytoracea turbinata* Schrammen (p. 156). COTYPE

Schrammen in describing this species figured two specimens from the Mucronatenkreide of Misburg (1910, Pl. XXIII, figs. 4, 5) and spoke also of the occurrences at Heere (pp. 156, 157). Since he did not designate a holotype, all of the specimens become cotypes, as does the single individual from Grosse Heere in the collection.

- 18249.
- Leiochonia pinguis*
- Schrammen (p. 159).

IDIOTYPE.

From the Cuvieri Pläner of Salder, Schrammen describes three specimens (given to him by Wollemann) as *L. pinguis* (1910, p. 159). He does not figure the type and fails to record the occurrence of the species at any other locality, yet there is a specimen in the collection labelled by him as coming from Heere, which is, therefore, an idiomorph.

- 18250.
- Macrobrochus emscheris*
- Schrammen (p. 174).

IDIOTYPE

There is a single specimen in the collection labelled *Macrobrochus emscheris* from the Cuvieri Pläner of Grosse Heere. This species was described by Schrammen in 1910 (p. 174) from the Westphalicuskreide of Ilsede, the holotype and only known specimen having come therefrom (photograph, Pl. xxiv, fig. 4; skeletal elements, text plate VIII, fig. 2) from the Untersenon of Adenstedt-Bühlten near Peine. The bottle of spicules in the collection constitutes, therefore, an idiomorph.

- 18251.
- Botryosella labyrinthica*
- Schrammen (p. 259).

PARATYPE AND METATYPE

For notes on this species see No. 18227. Schrammen described the species from the Cuvierikreide of Grosse Heere and stated that he had examined two specimens therefrom, one of which he figured (1910, text fig. 3). In the Museum Collection are two specimens and he had marked them in his manuscript list as types, but neither specimen corresponds to the illustration of the holotype, so that one is presumably the paratype and the other is a metatype, or both may be metatypes.

- 18252.
- Ventriculites radiatus*
- Mantell (p. 265).

PLESIOTYPES

See No. 18191.

- 18253.
- Ventriculites decurrens*
- T. Smith.

See No. 18192.

- 18254.
- Leiostracosia angustata*
- (Roemer) (p. 284).

PLESIOTYPE

See No. 18194.

- 18255.
- Plocoscyphia roemeri*
- Leonhard (p. 300).

HOMOTYPE

See No. 18185.

- 18256.
- Onchotæchus subrutus*
- (Quenstedt) (p. 309).

PLESIOTYPE

Quenstedt described and figured (1878, Pl. cxxxviii, figs. 2-6) this species as *Gyrispongia subruta* from material which he found at Dörnten, some 37 km. southeast of Hildesheim. Quenstedt (1878, p

480) states that probably *Achilleum formosa* Reuss belongs also to this species, but Hinde does not agree to this on account of the differences in form of spicules in the two species (Hinde, 'Fossil Sponges,' p. 135). Hinde has found this species in the Chalk Marl at Rocken End on the Isle at Wight. Schrammen has described the skeletal elements very fully and figured them on text plate xiv, fig. 7, in his Monograph. He has added a new locality to the places whence this sponge had already been obtained, for he has found it at Heere.

18257. **Tremabolites leonhardi** Schrammen (p. 217).

IDIOTYPE

Reuss in his 'Versteinerungen der böhmischen Kreideformation' notes the occurrence of *Manon megastoma* Roemer in the Upper Plänerkalk of Kutschlin and in the Lower Plänerkalk of Schillinge near Bilin, Bohemia (1845-1846, p. 77, Pl. xx, fig. 1; Pl. xlii, fig. 9). Schrammen considers that Reuss and other authors who have claimed that they have found this species in the Lower Turonian have been mistaken in their identifications and that the earlier forms are wholly distinct from the true *Manon megastoma* described by Roemer from the Senonian. For this reason Schrammen has erected the new specific name *leonhardi* for the Turonian forms (1910, p. 317). Previous to this change there had been a number of generic revisions. F. Roemer (1870, p. 307, Pl. xxxiii, fig. 6) placed the species in the genus *Camerospongia* because of certain external morphological characteristics. In 1878 ('Studien' I, p. 56) Zittel erected the generic name *Tremabolites* and included under the genus *Manon megastoma* Roemer. Počta in his first contribution on the 'Spongien der Böhmischen Kreideformation' (1883, p. 37) gave a very complete synonymy for *Tremabolites megastoma* including therein *Cephalites perforatus* T. Smith from the Lower Chalk of Burnham, Kent and Charing, England, *Porospongia megastoma* A. Roemer, *Pachyclænia megastoma* Pomel and *Cephalites polystoma* Quenstedt. Leonhard adopted Počta's synonymy and revision without adding anything new (1897, p. 36) except in the localities in which he mentions the Korycan beds of Bohemia, the Turonian of Löwenberg, the not infrequent occurrence at Oppeln (horizon not given, but presumably the Scaphites Pläner), the Senonian of Peine and the Quadraten of Westphalia, which last two are cut out by Schrammen who recognizes the Zittel generic revision, but who, as we have seen, proposes the specific name of *leonhardi* for the Turonian forms. Schrammen gives only the Scaphites Pläner of Oppeln for occurrences, therefore the specimen from Grosse Heere in the Museum Collection is an idotype.

18258. Aff. *Camerospongia fungiformis* (Goldfuss) non F. Roemer.

See No. 18198 for a discussion of these species. The specimen from Grosse Heere has the external appearance of the species described by Goldfuss, but a more accurate determination seems impossible.

SPONGES FROM THE EMSCHER MARL (SIPHONIEN MARL)

SPECIES FROM SUDMERBERG, NEAR GOSLAR, HANOVER

18259. *Pachypoterion koeneni* Schrammen (p. 63). PARATYPE

The holotype was described and figured from a specimen occurring in the Emscher Marl at Goslar (Schrammen, 1910, p. 63, Pl. xv, fig. 6). The species is also found at Sudmerberg, Bülten-Adenstedt and at Misburg, occurring in the last locality in the Kalkmergel of the Quadratenkreide.

18260. *Pachinion familiare* (Roemer) (p. 68). PLESIOTYPES

This species was described by Roemer as *Polycælia familiaris* from the Quadratenkreide of Sudmerberg (1864, p. 31, Pl. xi, fig. 10). While Zittel considered the species a *Cælocorypha* (1878c, p. 64), Schrammen, making a reëxamination of the skeletal elements, holds it to be a *Pachinion*. The specimen in the collection might be considered only among the typical specimens and as such would be a topotype, coming from the same locality and horizon as the type; but because Schrammen amplified the original description given by Roemer, which is characteristically meagre, and gave the dimensions and kind of skeletal elements present, the specimens must be considered plesiotypes.

18261. *Siphonia griepenkerli* Schrammen (p. 92). COTYPE

In the first edition of the 'Petrefacta Germaniæ,' Goldfuss described a sponge from the "Verhärteter Mergel von Coesfeld" (1826-33, p. 17) and figured in a most schematic way the under side of a specimen (Pl. xxx, fig. 5) which he called *Siphonia incrassata*. Roemer changed the generic designation to *Jerea*, but gave no illustrations and only one line of description (1864, p. 32); he referred to the Goldfuss figure and description. Zittel, in giving a list of the species which should be included under *Siphonia*, included *Siphonia incrassata* (Goldfuss) and cited the reference to that author; he gave no figure or description. In a similar manner, Hinde simply listed the species without comment (1883, p. 65), giving, however, a number of localities comprising: Bohemia (Plänerkalk); France, Vaches noires (*Craie Chloritée*); Ger-

many, Sudmerberg; he, too, cited the Goldfuss description. It is thus apparent that the three authors referred to *in seriatim*, who cited the Goldfuss species, added nothing to the original description and illustration. Thus, unless the Goldfuss holotype is accessible and could be described with precision by some one, it will not be possible to obtain an accurate definition of this species and the name cannot be used.

Griepenkerl has given a very good description and three clear illustrations of a sponge occurring in the Quadratenkreide of Glentorf in Braunschweig (1888-1889, p. 19, Pl. II, figs. 5a, b, c). This he calls *Siphonia incrassata* Goldfuss, but as Schrammen points out, there is no way of being sure that this form is really the Goldfuss species. Therefore, for Griepenkerl's species, Schrammen has proposed the new name *Siphonia griepenkerli* (1910, p. 92). Under this he includes parts or the whole of *Siphonia ficus* of authors, giving the following synonymy:

1841, *Siphonia ficus* Roemer, Kr., p. 4 (*pars*).

1878, *Siphonia ficus* Quenstedt, Petr., p. 412, Pl. CXXXIV, fig. 22 (not p. 431, Pl. CXXXV, figs. 20-23)

1878, *Siphonia ficus* Zittel, Studien II, p. 143, Pl. IX, fig. 6.

1883, *Siphonia ficus* Hinde, Catalogue, p. 65 (*pars*).

1888-89, *Siphonia ficus* Griepenkerl, Königsflutter, p. 19.

1888-89, *Siphonia incrassata* Griepenkerl, Königsflutter, p. 19, Pl. II, fig. 5a, b, c.

The species occurs in the Emscher Marl of Sudmerberg and in the Greensand of the Quadratenkreide of Glentorf.

The specimen in the collection is a plesiotype of *Siphonia incrassata* Griepenkerl *non* Goldfuss and a cotype of *Siphonia griepenkerli* Schrammen.

18262. **Trachysycon muricatum** (Roemer) (p. 96).

PLESIOTYPE

From the Quadratenkreide of Sudmerberg Roemer described *Placoscyphia muricata* (1864, p. 28, Pl. x, fig. 9) and Zittel made it the genoholotype of his monotypic genus *Trachysycon* (1878c, p. 140). The single specimen in the collection comes from the same locality and horizon as Roemer's holotype and is, therefore, a plesiotype of especial importance.

18263. **Lopadophorus janus** (Roemer) (p. 109).

PLESIOTYPE

This species was doubtfully ascribed to *Oculispongia* as *O? janus* by Roemer (1864, p. 48, Pl. XVI, fig. 12) who records it from the Quadratenkreide of Sudmerberg. The specimen figured by Schrammen is in the Palæontological Collection of the University of Göttingen. and is the largest one known to that author (1910, Pl. x, fig. 3). Schrammen

gave the first definite and complete description and the specimen in the American Museum Collection from the type locality must be looked upon as a plesiotype.

18264. *Verruculina angulata* Schrammen (p. 143).

COTYPE

Schrammen based his description of this species upon four specimens from the Lower Senonian Sandmergel of Sudmerberg, and since he did not figure or designate a holotype they are all cotypes, one of which is in the Museum Collection.

18265. *Stichophyma turbinata* (Roemer) (p. 144).

PLESIOTYPE

From the Obere Kreidemergel of Goslar Roemer described this species as *Manon turbinatum* (1841, p. 3, Pl. 1, fig. 5). Reuss identified an abundant form in the lowest Plänerkalk of Schillinge near Bilin, Bohemia, as *M. turbinatum* Roemer (1845-1846, p. 78) and gave several good illustrations (Pl. XIX, figs. 1-6). In his synonymy he includes with a question Phillips' *Spongia osculifera*. D'Orbigny in the 'Prodrome' assigns the *Manon turbinatum* of Reuss to his genus *Verrucospongia* (1850, II, p. 287), while Roemer's original species he places in his genus *Forospongia*. The *Manon turbinatum* of Reuss has finally been revised by Schrammen and put as a probable synonym of *Stichophyma verrucosa* (Roemer) *quid vide* (No. 18221).

In 1864 Roemer revised the generic standing of his own species and called it *Verrucospongia turbinata* (1864, p. 44), but this was an incorrect designation since D'Orbigny had already called the species identified by Reuss *Verrucospongia turbinata* and we have seen that the Reuss and Roemer species were not the same. Roemer in 1864 refers only to his own original *Manon turbinatum* and does not attempt to include Reuss' species as a synonym of his *V. turbinata*. At this time he states that Morris was in error in including *Manon turbinatum* Roemer 1841 in the synonymy of *Spongia osculifera* Phillips and that the latter species should rather be included in the synonymy of the former. Roemer is justified in this contention by the fact that Phillips gave no description of the form which he named and figured (1829, p. 118, Pl. 1, fig. 3), and since Roemer both figured and described *Manon turbinatum* and considered Phillips' species as a synonym of it, then we must accept Roemer's statement to that effect, for Phillips' specific name is only a list name and unless Roemer felt that he wished to give credit to Phillips as the author of the species no one else can do it; therefore the references in Morris' Catalogue are incorrect (1854, p. 28).

Zittel placed *Manon turbinatum* Roemer in Pomel's genus *Stichophyma*, while *Manon turbinatum* Reuss he assigned to *Stichophyma serialis* Pomel (Zittel, 1878c, p. 125). The skeletal elements of *S. turbinatum* he figured on Pl. iv, fig. 5.

Hinde lists, without figure or description, *Stichophyma turbinatum* (Roemer) accepting the Zittel revision (Hinde, 1883, p. 41).

Griepenkerl has given the first extensive description of the species and has stated that it is one of the commonest sponges in the Upper Quadraten beds of Glentorf, Braunschweig (1888-1889, p. 16).

Schrammen notes that the species is abundant in the Emscher Marl of Sudmerberg, and rather rare in the Upper Senonian Kalkmergel of Misburg.

18266. *Jereica punctata* (Münster) (p. 146).

PLESIOTYPE

From the Quadersandstein of Goslar, Münster described *Siphonia punctata* in the 'Petrefacta Germaniæ' (Goldfuss, 1826, p. 221, Pl. LXV, figs. 13a, b). Roemer in listing this species ascribes it to Schröter instead of Münster (1841, p. 4), noting its occurrence in the Obere Kreidemergel of Sudmerberg and in the Untere Kreidemergel of Ilseburg and Coesfeld.

Quenstedt under the name *Spumispongia punctatus foveatus* describes and figures a form (1878, p. 406, Pl. cxxxiv, fig. 13) which appears to correspond with Münster's species. Schrammen has included this species under the synonymy of *Jereica punctata* (Münster), but has given the wrong page and figure reference, citing 1878, p. 405, Pl. cxxxiv, fig. 12 instead of p. 406, Fig. 13.

Zittel placed *Jerea punctata*, which he assigned to Goldfuss not to Münster, in his genus *Jereica* (1878c, p. 127, Pl. v, fig. 1). Hinde accepted Zittel's generic revision and was the first author to ascribe the species to Münster instead of to Goldfuss as had commonly been done.

Schrammen has added little to our knowledge of this species, except that he has pointed out that it may be easily confused with *Cælocorypha subglobosa* von Zittel, especially when the summit is poorly preserved, since the under side of the two species is the same. A distinction is to be found in the central opening which is simple in *Cælocorypha subglobosa* while in *Jereica punctata* more or less numerous large postica cover the summit (1910, p. 146). He then explains how it happened that Quenstedt figured representatives of both of these species under the name *Spumispongia punctatus*.

18267. **Cælocorypha subglobosa** von Zittel (p. 152). PLESIOTYPES

Zittel erected this species to include a part of Quenstedt's comprehensive *Spumispongia punctatus* (Zittel, 1878, p. 128, Pl. II, fig. 4, Pl. VI, fig. 9) and he cited Pl. CXXXIV, figs. 9, 13, 14, 15 of Quenstedt (1876-1878) as the parts of *S. punctatus* to be included in his new species *Cælocorypha subglobosa*. Schrammen cites the same Quenstedt reference in his synonymy and refers to Zittel, reporting the species as abundant in the Emscher of Sudmerberg. Since Zittel in naming his new species based upon a part of Quenstedt's species figured a specimen from the Quadratenkreide of Sudmerberg, this place is the type locality. Zittel did not give a description of this species, although he gave a good generic description and figured the species. Since Schrammen has amplified the Zittel description the specimens from which his notes were made must be considered plesiotypes.

18268. **Cælocorypha socialis** (Roemer) (p. 152). PLESIOTYPE

This species was described by Roemer from the Upper Kreidemergel of Sudmerberg as *Scyphia socialis* (1841, p. 6, Pl. II, fig. 5). Both Zittel and Schrammen have the reference in their synonymies as *Siphonia socialis* Roemer, but that author did not describe a *socialis* under *Siphonia* and, furthermore, both Zittel and Schrammen give the figure reference which fits *Scyphia socialis*. There is no doubt that they referred to that species and that it was the one which Zittel included in his genus *Cælocorypha* (1878c, p. 128, Pl. IV, fig. 10). Schrammen has supplemented the original description from a study of three specimens which he collected from the type locality, one of which is in the American Museum Collection.

18269. **Cælocorypha acuta** (Roemer) (p. 153). PLESIOTYPE

From the Upper Kreidemergel of Sudmerberg, Roemer described *Scyphia acuta* (1841, p. 6, Pl. II, fig. 4) and he subsequently changed the generic designation to *Siphonocælia* (1864, p. 29). Zittel revised the species again, placing it under *Cælocorypha* (1878c, p. 128). Schrammen added very little further to the description except the dimensions of some of the specimens which he had collected from the type locality, for which reason his specimens are to be considered plesiotypes. He had examined five from Sudmerberg, one of which is in the collection.

18270. **Cytoracea impressa** (Roemer) (p. 155). PLESIOTYPE

Roemer described this species from the Quadratenkreide of Sudmerberg as *Stellispongia impressa* (1864, p. 49). Quenstedt figured two

specimens from the same locality under the name *Spongites impressus* (1876-1878, p. 374, Pl. CXXXIII, figs. 1, 2). Zittel referred this species to his genus *Astrobolia* (1878, p. 115). In his reference to Quenstedt's illustration he has fig. 12 instead of figures 1, 2—undoubtedly an error in proof reading. Schrammen supplemented the original description and placed the species under Pomel's emended genus *Cytoracea*, but he gave no illustrations (1910, p. 155).

18271. ***Cytoracea grandis*** (Roemer) (p. 155). PLESIOTYPE

This species was figured and described by Roemer as *Stellispongia grandis* from the Quadratenkreide of Sudmerberg (1864, p. 49, Pl. XVII, fig. 1). Zittel included it in *Astrobolia* (1878b, p. 51), but Schrammen placed it in *Cytoracea* (1910, p. 155).

18272. ***Cytoracea costata*** Schrammen (p. 155). HOLOTYPE OR METATYPE

Schrammen based his description of this species upon a single specimen from the Emscher of Sudmerberg. The specimen in the collection agrees with the description, but, unfortunately, Schrammen did not figure his holotype. Were it not for the fact that he so often stated that he had fewer specimens than he actually possessed, and were it not for his broad usage of the term *Belegstück*, one would unquestionably consider the specimen in the collection the holotype. If it is not, then it is only a metatype.

18273. ***Bolidium palmatum*** (Roemer) (p. 158). PLESIOTYPE

This species was described by Roemer (1864, p. 55, Pl. XIX, fig. 8) from the Quadratenkreide of Sudmerberg as *Amorphospongia palmata*. Subsequently Zittel erected the genus *Bolidium* for a number of species characterized by their indefinite form and absence of large ostia or canals and having skeletal elements very similar morphologically to those of the genera *Astrobolia* and *Chonella*. The species, so far, is known only from Sudmerberg. Počta (1884, p. 10) has recorded the finding of two specimens at Kamajk, Bohemia, in the Korytzan beds, but Schrammen questions the identification. Počta does not figure his specimens. Hinde listed the species from Sudmerberg without description or figure (1883, p. 31). Schrammen adds a few points to the original description, giving dimensions and so forth.

18274. ***Chonella auriformis*** (Roemer) (p. 161). PLESIOTYPE

See No. 18223.

18275. **Seliscothon marginatum** (Roemer) (p. 166).

PLESIOTYPES

From the Obere Kreide of Goslar Roemer figured and described *Scyphia marginata* (1841, p. 6, Pl. II, fig. 7). Quenstedt makes reference to this species and figures a specimen from Sudmerberg (1876-1878, p. 376, Pl. CXXXIII, fig. 5). In 1850 D'Orbigny made *Scyphia marginata* a synonym of Phillips' species *Spongia capitata*, changing the generic designation to *Cupulospongia*. Roemer quite rightly does not accept D'Orbigny's revision, except for the genus, and considers that his own specific name *marginata* has priority, because Phillips did not describe his species (Roemer, 1864, p. 50). Roemer not only includes *Spongia capitata* Phillips in his synonymy of *Cupulospongia marginata* but places there also *Spongia plana* and *Spongia terebrata* by the same author. Such a proceeding is unwarranted as one may judge from a study of Phillips' illustrations, and later authors have not followed Roemer in this step. *Cupulospongia marginata* Roemer is placed by Zittel in his new genus *Seliscothon* (1878, p. 118), a revision which Griepenkerl, Wolle-
mann, and Schrammen have accepted, although Schrammen omits reference to Zittel in his synonymy. Griepenkerl reports the rare occurrence of this species in the Upper Quadraten of Glentorf, Braunschweig (1888-1889, p. 16). Wolle-
mann notes its presence in the Senonian at Gr. and Kl. Bienwende in Braunschweig (1901, p. 4), while Schrammen collected from Sudmerberg (1901, p. 166).

18276. **Pachytrachelus conicus** (Roemer) (p. 171).

PLESIOTYPE

Roemer described this species as *Cnemidium conicum* from the Emscher Marl of Sudmerberg (1841, p. 4, Pl. I, fig. 10). From the same locality and horizon Roemer subsequently described and figured another species, *Eudea tuberosa* (1864, p. 25, Pl. x, fig. 13) which Schrammen, who had access to the holotypes, considers to be the same as *Cnemidium conicum*. In 1864 Roemer accepted doubtfully the reference of his original species to D'Orbigny's *Stellispongia* which the latter author had made in the 'Prodrome' (1850, II, p. 287). Quenstedt called the species *Spongites conicus* (1878, p. 374) and figured a specimen from Sudmerberg (*loc. cit.*, Pl. CXXXIII, fig. 3).

Schrammen has added to the original description and has given two illustrations of a specimen from the type locality (1910, Pl. XXIV, figs. 1a, 1b); he states that it is abundant in the railroad cutting at Petersberg, near Goslar, Hanover.

SPONGES FROM THE SENONIAN

The Quadratenkreide (Zone 1 of the Obersenon of Schlüter;
Zone 3 of Stolley)

SPECIES FROM THE QUADRATENKREIDE OF OBERG, HANOVER

18277. *Tettilopsis longitridens* (Schrammen) (p. 50). HOLOTYPE (Spicules)

Schrammen founded this species upon a single specimen from the Kalkmergel of the Quadratenkreide of Oberg. He figured only the skeletal elements of the holotype (1910, p. 50, text plate I, fig. 7). The specimen in the Museum Collection is a bottle of spicules presumably from the holotype.

18278. *Stolleya ornatissima* Schrammen (p. 51). HEAUTOTYPE

This species was described and figured from a single specimen from the Quadratenkreide of Oberg (1899, p. 7, Pl. I, fig. 4; skeletal elements, text plate IV, fig. 5). Subsequently the number of specimens which Schrammen examined was increased to twelve and included some from the Mucronatenkreide of Misburg (1901, p. 51; skeletal elements, text plate I, fig. 1). Since the specimen in the Museum is not the holotype, it is to be classed among the supplementary types as a heautotype, having been one of those selected by the describer to further illustrate his holotype.

18279. *Stolleya microtulipa* Schrammen (p. 51). PARATYPE OR HEAUTOTYPE

This species is one of two genosyntypes of Schrammen's *Stolleya* founded in 1899. *S. microtulipa* was described from three specimens from the Quadratenkreide of Oberg, but only the skeletal elements were figured (1899, p. 7, Pl. III, fig. 3). Schrammen listed it in 1901 without further description or illustration (1901, p. 19). In his Monograph, Schrammen amplified the original description (1910, p. 51), figured a few more skeletal elements (text plate I, fig. 2), and noted the occurrence of the species from the Mucronatenkreide of Misburg. In the Museum Collection are one specimen and a bottle of the spicules which are paratypes, since the figured skeletal elements accompanying the protolog must be considered the holotype. It is possible, as in the case of nearly all of the species described by Schrammen prior to 1910, that the specimen in the Collection is not one of the original series and therefore not a paratype, but belongs to material collected by Schrammen subsequent to the time of description and it would in that case be a heautotype.

18280. *Stolleya florida* Schrammen (p. 54). HOLOTYPE (Spicules)

The holotype of this species is a single specimen described but not figured by Schrammen in 1910 (p. 54; skeletal elements, text plate 1, fig. 5) from the Quadratenkreide of Oberg. In the Museum Collection is a bottle of spicules presumably from the holotype, since Schrammen characterizes the species as "unicum."

18281. *Theneopsis steinmanni* (von Zittel) Schrammen (p. 55). PLESIOTYPE

Zittel in 1879 ('Studien,' III, p. 9) erected the genus *Tethyopsis* for a single specimen from the Mucronatenkreide of Ahlten which he called *T. steinmanni*. This species was not described, but the holotype was figured (*loc. cit.*, Pl. XI, fig. 3). The generic name was given because of the close similarity of the Cretaceous form to a species of the living genus *Tethya*. Schrammen, in his Monograph, discards Zittel's name and proposes *Theneopsis*, because *Tethyopsis* had already been pre-empted for a living species belonging to the same family of the Stellettidæ, *Tethyopsis columnifer* Stewart (Quart. Journ. Micr. Sc. 1870, p. 281). Schrammen evidently had not discovered this fact at the time of publication of his earlier papers, for in 1899 and 1901 he accepted the generic name proposed by Zittel (1899, p. 19; 1901, p. 19). To the original locality and horizon Schrammen has added discoveries from the Quadratenkreide of Oberg and Misburg and from the Mucronatenkreide of Misburg (1910, p. 55, Pl. XII, fig. 1; skeletal elements text plate 1, fig. 5). Since Schrammen gave the first description of the species his specimens are plesiotypes.

18282. *Doryderma (Brochodora) roemeri* (Hinde) (p. 58). PLESIOTYPE;
See No. 18180.

18283. *Doryderma (Brochodora) ramusculus* Schrammen (p. 59):

PARATYPES

Schrammen described this species from the Quadratenkreide and Mucronatenkreide, from Misburg, Oberg and Adenstedt. The figured holotype comes from the Quadratenkreide of Oberg, but neither of the two specimens in the Collection corresponds to the illustration (1910, Pl. XVIII, fig. 6).

18284. *Doryderma (Homalodora) ramosa* (Mantell) (p. 59). PLESIOTYPES=

Mantell described and figured this species as *Spongia ramosa* (1822 = p. 162, Pl. xv, figs. 8, 11) and the holotype is now in the British Museum.

The type horizon and locality were the Upper Chalk near Lewes and Brighton, Sussex. Hinde, in his synonymy, includes Parkinson's "ramose alcyonite" figured on Pl. VII, fig. 6 in Vol. II of the 'Organic Remains' and described on page 92 in that volume. The specimen figured by Parkinson came from Berkshire. Zittel included the species in his genus *Doryderma* (1878c, p. 132) without further description or illustration. Hinde, who had examined Mantell's type, accepted Zittel's revision, gave a detailed description of the species and figured a specimen from Oare, Wiltshire (1883, p. 48, Pl. VIII, figs. 2, 2a). Schrammen recognized a more refined classification than that given by Zittel and made a new subgenus, *Homalodora*, for those forms having a dense or solid skeleton and in which the surface was fine-meshed and smooth with irregularly disposed, round ostia (1910, p. 59). Here he placed *D. ramosa*, figuring a specimen from the Quadratenkreide of Oberg (*loc. cit.*, Pl. XVIII, fig. 7), and noting its occurrence also in the Mucronatenkreide of Misburg.

18285. *Doryderma* (*Homalodora*) *plana* Schrammen (p. 59). COTYPES

This species was described from twenty specimens coming from Misburg and Oberg, the two figured cotypes coming from the Quadratenkreide of Oberg (1910, p. 59, Pl. XVII, figs. 3, 4). The two specimens in the American Museum Collection are cotypes, but are not the figured specimens.

18286. *Doryderma* (*Homalodora*) *tuberosa* Schrammen (p. 60). COTYPES

The two specimens in the collection are from among the cotypes upon which Schrammen founded this species. He examined ten specimens from the Mucronatenkreide and Quadratenkreide of Misburg and Oberg, but did not figure or select a holotype.

18287. *Doryderma* (*Homalodora*) *ficus* Schrammen (p. 60). PARATYPES

Schrammen's figured holotype of this species comes from the Quadratenkreide of Oberg (1910, p. 60, Pl. XVII, fig. 2). There are five specimens from this locality in the Collection, two being young individuals. The form has also been found in the Mucronatenkreide of Misburg. On account of its small size and form it might easily be confused with the young of *Amphilectella piriformis*. But *D. ficus* has "in the central portion of the summit not a simple osculum, but numerous postica 2 mm. wide and fine-meshed skeleton" (Schrammen, 1910, p. 61).

18288. *Amphilectella piriformis* Schrammen (p. 61). HEAUTOTYPES

In 1901 Schrammen made a subdivision of Zittel's genus *Doryderma*, erecting the subgenus *Amphilectella* with *A. piriformis* as the "subgenoholotype" (1901, p. 13). The figured holotype is from the Mucronatenkreide of Misburg (*loc. cit.*, Pl. III, fig. 3) and is now in the Roemer Museum. Schrammen recorded the occurrence of the species also in the Quadratenkreide. In 1910 he raised the subgenus to the rank of a genus (p. 61) and was able also to add Oberg to the locality list. By means of his additional material he amplified his original description and figured a specimen from Oberg (1910, p. 61, Pl. XVIII, fig. 8; skeletal elements, text plate II, fig. 6). (See also No. 18203).

18289. *Heterostinia obliqua* (Benett) Hinde (p. 62). PLESIOTYPE

From the Gray Sand and Chalk flints of Warminster and Wiley, Miss Benett listed and figured a species which she called *Polypothecia obliqua* (1831, p. 9, Pl. VIII, figs. 1, 2). Hinde placed the species in Zittel's genus and gave a full description of it with illustrations both of an individual specimen and of the skeletal elements (1883, p. 53, Pl. x, figs. 2, 2a, 2b, 2c). He explained that while Miss Benett had given no description of the species her illustrations left no doubt as to the sponge she had in mind, for there was no other from Wiltshire with the "peculiar elongated compressed stem or root shown in her figure." As Hinde pointed out, there was no certainty that the *Chenendopora obliqua* figured and described by Michelin (1840-1847, p. 132, Pl. XLI, figs. 2a, b) was the same as Miss Benett's *Polypothecia obliqua*, although Michelin made her species a synonym of his. Since Michelin undoubtedly had not seen Miss Benett's types, but depended solely upon the illustrations which she gave, and since Hinde had collected from the type locality and questioned Michelin's identification of the French forms with those from Wiltshire, we must consider that Michelin's species is distinct.

Schrammen includes in his synonymy of *H. obliqua* two species which he described in 1901 as genosyntypes of his *Asteroderma*, namely, *A. expansa* (1901, p. 14, Pl. III, fig. 4) and *A. conica* (p. 14, Pl. I, fig. 9). Schrammen has figured specimens from the Quadratenkreide of Oberg (Pl. XVI, fig. 2) and the Mucronatenkreide of Misburg (Pl. XVI, fig. 3, Pl. XVII, fig. 1).

18290. *Heterostinia immanis* Schrammen (p. 63). IDIOTYPE

For a complete discussion of this species see No. 18471.

Schrammen states in his Monograph that this species is confined to the Mucronatenkreide of Misburg, yet in the Museum Collection is a bottle of skeletal elements labelled by Schrammen himself from the Quadratenkreide of Oberg.

18291. **Pachypoterion auritum** Schrammen (p. 64). IDIOTYPE

The figured holotype of this species from the Mucronatenkreide of Misburg is stated by Schrammen to be the only known specimen, yet the fragments and spicules in a bottle in the Museum Collection are labelled by Schrammen himself and must have been overlooked by him when he was recording his occurrences.

18292. **Pachinion scriptum** (Roemer) (p. 67). PLESIOTYPES
See No. 18204.

18293. **Pachinion cylindricum** Schrammen (p. 68). HEAUTOTYPE

This species was originally the genoholotype of Schrammen's monotypic genus *Neohindia* (1901, p. 11). The figured holotype, now in the Roemer Museum, came from the Quadratenkreide of Misburg (*loc. cit.*, Pl. II, fig. 5; skeletal elements, Pl. v, fig. 2). This genus, furthermore, was the type for Schrammen's family Neohindiadæ. When he published his Monograph, Schrammen, having better material at hand, found that *N. cylindrica* was in reality a *Pachinion*. Consequently the genus *Neohindia* was left without a species and the family Neohindiadæ without a genus, both names thus becoming *nomina nuda*. While the specimen in the Museum Collection is quite as perfect as the figured one, it is, unfortunately, not the holotype. Schrammen states explicitly (1910, p. 69) that this species occurs only in the Quadratenkreide of Misburg in spite of the fact that he figured a specimen from the Quadratenkreide of Oberg and that he had labelled a specimen and bottle of spicules from Oberg which are now in the American Museum Collection. Since, however, he has figured a specimen from Oberg (1910, Pl. XVIII, fig. 3), even though he has failed to include that place in his localities, the specimen in the collection is a heautotype.

18294. **Procorallistes polymorphus** Schrammen (p. 69). PARATYPE OR HEAUTOTYPE

See No. 18236.

18295. **Propachastrella primæva** (von Zittel) (p. 71). PLESIOTYPE

In the third part of his 'Studien über fossile Spongien' Zittel, in 1879 (p. 10), described a new species, *Pachastrella primæva* (Pl. XI, fig.

4),¹ from the Quadratenkreide of Ahlten. In 1883, Hinde ('Catalogue,' p. 26, Pl. II, figs. 1, 1a) described from the Upper Chalk of Flamborough a new species *Pachastrella convoluta* which he states may be distinguished from *P. primæva* Zittel "by its mode of growth and also by the dimensions of the spicules." He admits that in form and arrangement of the spicules the two species are alike. His criteria of distinction are evidently not well taken, and Schrammen seems entirely justified in not admitting the British form as a new species.

In 1885 Počta ('Beiträge,' III, p. 8) identified certain skeletal elements which he had found in the Weissenberg beds of Rencov with Hinde's *Pachastrella carteri* (1889, 'Spicules,' p. 46, Pl. III, figs. 29-31) and this also Schrammen includes under *Propachastrella primæva*, a procedure which seems entirely justified on the basis of the form of skeletal elements. In 1899 ('Tetractinelliden,' p. 8) Schrammen placed *Pachastrella primæva* under Gray's genus *Dercitus*, but in 1910 he made a new genus *Propachastrella*, because the Mesozoic genus differs from the related recent ones *Dercitus* Gray, *Pachastrella* Oscar Schmidt and *Calotropella* Sollas in "the possession of a dermal covering of dichotrizens" (1910, p. 71). The species *primæva* is the only Mesozoic Pachastrellid which has been found in entire specimens; all others are known either from fragments or from spicules alone. (See Schrammen, 1910, Pl. XIII, fig. 1, illustration of large specimen from the Mucronatenkreide of Misburg.)

18296. *Phymatella intumescens* (Roemer) (p. 73).

HOLOTYPE

See No. 18206.

18297. *Phymatella bulbosa* von Zittel (p. 75).

PLESIOTYPES

See No. 18207.

18298. *Phymatella tuberosa* (Quenstedt) (p. 76).

PLESIOTYPES

Quenstedt described this species as *Scyphia tuberosa* from the Quadratenkreide of Köhlerholz near Ilsenburg (1876-1878, p. 388, Pl. CXXXIII, figs. 18-20). He thought it was the same as Roemer's *Scyphia tuberosa* ('Verst. Norddeutschen Kreidegeb.,' 1841, Pl. II, fig. 9) but, according to Schrammen (1910-1912, p. 3), Roemer's type cannot be identified either as to genus or family. Quenstedt's *tuberosa* is, therefore, a

¹Through an apparent oversight in proof-reading the reference given by Zittel for the figure of this specimen is Pl. XII, fig. 4, whereas it should be Pl. XI, fig. 4, as is readily seen by reference to the plates in question and to their description. Several subsequent authors have copied the incorrect reference.

distinct species and has been shown by Zittel (1878, p. 138) to belong to his genus *Phymatella*.¹ He retained the name *tuberosa* but credited it to Quenstedt, a procedure which is justifiable because Quenstedt's *tuberosa* did not belong to the genus under which Roemer had placed his *tuberosa*.

Schrammen suggests that probably the species *Scyphia attenuata*, *S. lobata* and *S. mamillata* of Courtiller (1859, p. 122, Pl. v, figs. 2-5, Pl. vi, fig. 1) belong to *Phymatella tuberosa* (Quenstedt).

This species is reported by Schrammen only from the Quadratenkreide and Mucronatenkreide and from Misburg, Oberg and Ilsenburg. He appears to have overlooked the specimen from the Scaphites Pläner of Nettlingen.

18299. *Phymatella sphaeroides* Schrammen (p. 76).

COTYPES

This species was described by Schrammen from the Quadratenkreide and Mucronatenkreide, from Oberg and Misburg (1910, pp. 76, 77), the figured cotypes being from the Quadratenkreide of Oberg (*loc. cit.*, Pl. I, figs. 6-8). None of the three specimens in the collection is a figured one.

18300. *Phymatella heteropora* von Zittel (*non* Roemer) (p. 77).

PLESIOTYPE

In 1878 Zittel erected the genus *Phymatella* (1878c, p. 137) and included under it *Scyphia heteropora* Roemer. This had been described in 1841 from the Upper Kreidemergel of Sudmerberg (Roemer, 1841, p. 7), and a poor illustration of the holotype had been given (Pl. II, figs. 13 a, b). Zittel gives no description of *Phymatella heteropora* (Roemer); but figures some tetracles from a fragment from the Mucronatenkreide of Ahlten (1878c, Pl. VIII, fig. 2). Zittel had not seen Roemer's type and Schrammen thinks that it would be impossible to tell solely from Roemer's very brief description and sketchy protograph whether or not *Scyphia heteropora* was a *Phymatella*. Schrammen, after a study of Roemer's holotype and other type material, came to the conclusion that *S. heteropora* was not a *Phymatella*, for which reason *Phymatella heteropora* Zittel is distinct from *Scyphia heteropora* Roemer. Schrammen (1910, p. 77) describes ten specimens from the Kalkmergel of the Quadraten- and Mucronatenkreide, from Misburg, Ahlten and Oberg, figuring one specimen from the Quadratenkreide of Oberg (1910, Pl. III, fig. 1).

¹Zittel in his 'Studien' (II, p. 138) incorrectly refers to Quenstedt's species as *Sponites tuberosus*. It is possible that the error is due to Quenstedt's manner of having generic and specific names printed, for he always has the latter in bold face type while the former are in Roman type. A number of species just preceding *tuberosus* had been under the genus *Spongites* and a reasonable explanation seems to be that Zittel overlooked the transition to *Scyphia*.

18301. ***Aulaxinia sulcifera*** (typica) (Roemer) (p. 78). PLESIOTYPE

This species was described by Roemer (1864, p. 30, Pl. xi, fig. 7) as *Siphonocelia sulcifera*, from the Mucronatenkreide of Dolberg near Hamm and the Quadratenkreide of Ilsenburg. Zittel ('Studien,' II, 1878c, p. 138), subdividing Roemer's genus *Siphonocelia*, placed certain of the species in a new genus *Aulaxinia*. He adds further occurrences from Linden and Ahlten. Griepenkerl has identified this species as of rare occurrence in the Quadratenkreide at Boimstorf, Braunschweig (1898-1899, p. 18). Schrammen has added the localities of Oberg. Glentorf, Misburg, Biewende and Adenstedt to those already known (1910, p. 78) and has figured three specimens from the Quadratenkreide of Oberg, none of which is among the five in the Museum Collection.

18302. ***Craterella tuberosa*** Schrammen (p. 80). HEAUTOTYPES

Schrammen described this species from the Quadratenkreide of Misburg and Oberg figuring from the former locality a large specimen which is now in the Roemer Museum (1901, p. 5, Pl. II, fig. 2). This species was the genoholotype and sole species in the genus at the time of description. By an oversight, Schrammen omitted in his Monograph reference to Oberg as one of the localities at which this species is found, although he figured a specimen therefrom (Pl. III, fig. 3) and there are three specimens in the Museum Collection.

18303. ***Myrmeciophytum verrucosum*** (Roemer) (p. 81). PLESIOTYPES

Roemer described this species in 1864 as *Stellispongia verrucosa* from the Quadratenkreide east of Sottmar and from Gr. Biewende (1864, p. 50). The figured holotype was only a fragment (*loc. cit.*, Pl. xvii, fig. 5) and the specimen figured by Schrammen is hardly any better except that the illustration is well executed (1910, Pl. iv, fig. 1; skeletal elements, text plate iv, fig. 3).

18304. ***Callopegma acaulis*** von Zittel (p. 81). PLESIOTYPES

From the Mucronatenkreide of Ahlten, Linden and Ciply, Zittel described this species in 1878 ('Studien,' II, p. 139). Hinde in his 'Catalogue' (1883, p. 61) described a species from the Upper Chalk of South England as *Callopegma obconicum*. Schrammen considers that the characteristics cited by Hinde as distinguishing his species from *C. acaulis*, namely, "its smaller size, the absence of a cup in the centre, and its even surface" are not necessarily those of a new species, but

simply of the young of *C. acaulis*. He holds that the figure given by Hinde of *C. obconicum* is that either of a young *C. acaulis* or else of an adult form from beds of earlier age than the Quadratenkreide. Schrammen reports it from Ilsede, Misburg, Adenstedt, and Ahlten and figures two specimens from the Quadratenkreide of Oberg (Pl. iv, figs. 3, 4; skeletal elements, text plate iv, fig. 9). The species ranges from the Lower Senonian sand marl through the Mucronatenkreide (1910, pp. 81, 82).

18305. *Thecosiphonia postumus* Schrammen (p. 85).

PARATYPES

This is a very small species which was described by Schrammen (1910, p. 85, text plate iv, fig. 4) from eight specimens from the Quadratenkreide of Oberg. There are five specimens in the Museum Collection which are all paratypes, if we consider that the skeletal elements figured are the holotype.

18306. *Turonion variabilis* Michelin (p. 86).

PLESIOTYPE

This is one of the few species described before 1850 which has retained its original name to the present day without generic revision by later students of the sponges. At the time of description *variabilis* was the genoholotype of the monotypic genus *Turonion*, a name given by Michelin because of the abundance of this species in the environs of Tours (1840-1847, pp. 125, 126). The specific name was chosen because of the great variability in form and size displayed by this sponge as shown in the figures of the many cotypes (*loc. cit.*, Pl. xxxv, figs. 1-8). Michelin records it from the Cretaceous of Chateaufvieux near Saint-Aignan (Loir-et-Cher) and in the environs of Tours (Indre-et-Loire). Bronn, in the third edition of the 'Lethæa Geognostica,' described this species briefly and reproduced one of Michelin's figures (1852, part 5, p. 60, Pl. xxviii, fig. 8). Fromental changed Michelin's generic name to *Turonifungia* to correspond to the system of nomenclature which he erected, but which has not been followed by later authors. He took Michelin's description, adding nothing to it, giving no new localities nor any figures and, therefore, the name *Turonifungia* has no standing. Fromental's plan of having uniform endings for all of the generic names in one family has its good points, but, unfortunately, cannot be adopted, if we adhere to the laws of priority. Courtiller figured and briefly described this species (1859, p. 141, Pl. xl, figs. 2, 3, 4) and of the illustrations Schrammen considers Fig 2 to be a true *T. variabilis*, including here also Courtiller's *T. sulcata* (*loc. cit.*, p. 141, Pl. xl, fig. 1). In this

latter step he follows Zittel who accepts Michelin's descriptions and names and who includes the *T. sulcata* of Courtiller under the *T. variabilis* of Michelin (1878, II, p. 150). Hinde accepted all of Zittel's classification and noted the occurrence of the species in the Upper Chalk of Flamborough and of the South of England (1883, p. 76).

Schrammen has added two northwest German localities to those already known, reporting it from the Quadratenkreide of Oberg and the Quadratenkreide and Mucronatenkreide of Misburg (1910, pp. 86, 87) whence he has figured five specimens (Pl. XI, figs. 1-3, Pl. III, figs. 8, 9). The specimen in the Museum Collection from the Quadratenkreide of Oberg is not one of those figured. The species is very rare and small in the higher beds of the Quadratenkreide, but becomes more abundant, very much larger, and extremely variable in form in the Mucronatenkreide where Schrammen has found specimens up to 15 cm. in height and 30 cm. in thickness (1910, p. 87).

Michelin's protolog, supplemented by the numerous illustrations is sufficient to make it clear what sponge he was describing, yet it lacks all the details regarding structure and form which later day writers give. Especially is the protolog inadequate in that it contains no description of the skeletal elements. There was a very real need of a redescription and this Schrammen has given. The specimens from north-western Germany which he used for this purpose are thus plesiotypes.

18307. *Turonia constricta* von Zittel (p. 87).

PLESIOTYPES

From the Mucronatenkreide of Ahlten, Zittel described this species (1878c, p. 150), but he figured only the skeletal elements (*loc. cit.*, Pl. IX, fig. 3). Schrammen gave a fuller description of the species (1910, p. 87) based upon thirty specimens collected by him from the Quadratenkreide of Oberg and the Mucronatenkreide of Misburg, from the former of which he figured three specimens (Pl. III, figs. 5-7) and also the skeletal elements (Text Plate IV, fig. 6). Since the Schrammen material was used to further describe and illustrate Zittel's description, the fourteen specimens from Oberg are all plesiotypes.

18308. *Turonia cerebriformis* Schrammen (p. 88).

COTYPE

Schrammen described this species and figured two cotypes (1910 p. 88, Pl. III, figs. 10, 11; skeletal elements, text plates IV, fig. 7) from the Quadratenkreide of Oberg to which horizon and locality he says the species is confined. However, there are specimens in the American

Museum Collection from another horizon and locality so that it is not so restricted as would appear to be the case from Schrammen's statement in print. (See No. 18478.)

18309. *Jerea quenstedti* von Zittel (p. 89).

FIGURED PLESIOTYPE
AND PLESIOTYPES

See No. 18182 for discussion of this species. There are six plesiotypes from Oberg, one of which, a young individual, is figured (Schrammen, 1910, Pl. II, fig. 4). Unfortunately the lower half inch of the specimen has been broken off and is missing.

18310. *Jerea gracilis* Schrammen (p. 91). (Figured).

HOLOTYPE

The specimen of this species in the American Museum Collection is labelled *Jerea* sp. nov. by Schrammen. By a comparison with the description and illustration of the only new species of *Jerea* described in the Monograph, it was possible to determine that the specimen so labelled is the figured holotype of *J. gracilis* from the Quadratenkreide of Oberg (1910, p. 91). Only two specimens had been examined by Schrammen and the species is unknown elsewhere. On the surface of the specimen is a triangular break, where a portion has dropped out; in the figure the piece is still in place, but cracks are represented, marking the outline of the present hole in the surface (*loc. cit.*, Pl. II, fig. 5). This is the only figured holotype in the collection.

18311. *Siphonia tubulosa* (Roemer) (p. 93).

PLESIOTYPES

Roemer described this species from the Lower Cretaceous of Peine, Hanover (1841, p. 8, Pl. III, fig. 10) as *Scyphia tubulosa*, a name which has been changed by Schrammen to *Siphonia tubulosa*. In 1888-1889, Griepenkerl described from the Quadratenkreide of Glentorf a form which he called *Siphonia ovalis* (1888-1889, p. 93, Pl. III, figs. 3a, b). His description and illustrations are good so that there can be no doubt of the form that he had in mind. With this definite information regarding the species from Königslutter and having Roemer's type material to consult, Schrammen came to the conclusion that Griepenkerl's species was synonymous with Roemer's *Siphonia tubulosa*. It is unfortunate that the three specimens figured by Schrammen (1910, Pl. II, figs. 6-8; skeletal elements, text plate IV, fig. 11) were all young individuals, for there is thus no good illustration in the literature of Roemer's species, the original figure as usual being very poor. In the Museum Collection are two young individuals and four others.

18312. *Siphonia micropora* Schrammen (p. 94).

COTYPES

This species was described by Schrammen (1910, p. 94) from six specimens which he had examined from the Quadratenkreide of Oberg of which he figured two (Pl. II, figs. 9, 10; skeletal elements, text plate IV, fig. 10). There are three specimens in the Museum Collection but none corresponds to any of those figured.

18313. *Acrochordonia ramosa* Schrammen (p. 96).PARATYPES OR
HEAUTOTYPES

In 1901 (p. 6), Schrammen erected the genus *Acrochordonia* with the single species and genoholotype *ramosa* (p. 7, Pl. I, fig. 8, Pl. V, fig. 1). The holotype is in the Roemer Museum. The species is known only from the Quadratenkreide of Oberg. In 1910 Schrammen gave a fuller description (p. 96) and figured two more specimens from Oberg (Pl. IV, figs. 5, 6; text plate VI, fig. 10). The five specimens in the collection may be either paratypes or heautotypes, depending upon whether they were part of the original series or belonged to the supplementary material.

18314. *Acorchordonia auricula* Schrammen (p. 97).

PARATYPE

Schrammen described this species in 1910 from the Quadratenkreide of Oberg figuring the holotype (Pl. IV, fig. 7), the description of which was based upon three specimens. In the American Museum Collection the only representative is a bottle full of small fragments.

18315. *Discodermia antiqua* Schrammen (p. 97). COTYPES OR HEAUTOTYPES

This species was described by Schrammen in 1901 (p. 5) from specimens from the Quadratenkreide of Oberg and the Mucronatenkreide of Misburg, although the figured cotypes are all from the former locality and horizon (Pl. I, figs. 2-4; skeletal elements, Pl. IV, fig. 3) and are now to be found in the Roemer Museum. In his Monograph, Schrammen has figured three more specimens from the Quadratenkreide of Oberg (Pl. VIII, figs. 1-2, Pl. VII, fig. 7) and reprinted on Pl. VII, figs. 5, 6 the two original figures. There are six specimens in the Museum Collection, but none is figured.

18316. *Rhagadinia rimosa* (Roemer) (p. 100).

PLESIOTYPES

In 1864 Roemer described *Cupulospongia rimosa* (p. 51, Pl. XVIII, fig. 8) from the Mucronatenkreide of Ahlten and the Quadratenkreide of Ilsenburg. Parts of Roemer's genus *Zittel* separated out for a new

genus *Ragadinia* (1878c, 'Studien,' II, p. 152, Pl. x, fig. 4). At that time *rimosa* was the only species to be placed under this genus, though Zittel states that the abundant material from Ahlten includes two or three different species. Pořta (1884, p. 41) records the occurrence of a single poorly preserved specimen in the Korytzan beds of Kollin (Pl. II, fig. 14); he figures only the skeletal elements, the sponge itself being in too poor a state of preservation. Schrammen (1910, pp. 100-101) states that he has examined over 100 specimens and he adds to previously known localities Oberg, Misburg, and Adenstedt, from the first two of which he has figured four specimens (Pl. VII, fig. 4, Pl. VIII, figs. 6, 7, Pl. x, figs. 5, 6; skeletal elements, text plate v, fig. 3).

18317. *Rhagadinia doederleini* Schrammen (p. 101).

METATYPE

Schrammen described this species in 1910 from two specimens obtained by him from the Kalkmergel of the Quadratenkreide of Oberg. He figured the upper and lower surfaces of one large platter-shaped specimen (Pl. VII, figs. 1 and 2) and a single view of a smaller auriforme one (Pl. VII, fig. 3). In the American Museum Collection is a specimen which closely parallels this third figure, but it is labelled *Discodermia doederleini* Schrammen. Since Schrammen described no species of that name under *Discodermia* and since the specimen in the collection is evidently a *Rhagadinia*, I have placed it under that genus. It comes from Schrammen's type locality, but not having been used by him in the literature it is only a metatype. It is likely that Schrammen at first identified his specimen as a *Discodermia* and later changed the determination to *Rhagadinia*.

18318. *Colossolacis plicata* Schrammen (p. 103).

COTYPES

This species is the genoholotype of the monotypic genus *Colossolacis*. It was described in 1910 by Schrammen (p. 103, Pl. VIII, fig. 5, Pl. IX, figs. 1, 2; text plate v, fig. 1) from three specimens from the Quadratenkreide and Mucronatenkreide and from Misburg and Oberg. There is one fairly large fragment in the Museum showing the interior and exterior of the wall and the size and arrangement of ostia and postica. There is also a bottle of small fragments.

18319. *Rhoptrum scytaliforme* Schrammen (p. 104).

COTYPES

This species is the genoholotype of Schrammen's monotypic genus *Rhoptrum*. The description is based upon four specimens from the Quad-

ratenkreide of Oberg (Schrammen 1910, p. 104, Pl. v, figs. 5-7; text plate v, fig. 2). There are in the Museum Collection two specimens, a third identified *affine* and a bottle containing a few spicules.

18320. ***Phymaraphinia infundibuliformis*** Schrammen (p. 105).

COTYPES OR HEAUTOTYPES

This species was described as the genoholotype of the monotypic genus *Phymaraphinia* by Schrammen in 1901 (p. 9, Pl. i, figs. 6, 7, Pl. iv, fig. 8), the originals of the figured cotypes coming from the Mucronatenkreide of Misburg and the Quadratenkreide of Oberg and being now in the Roemer Museum. In 1910 (p. 105) Schrammen amplified the description figuring one new specimen from each of the two localities just mentioned (Pl. v, figs. 1, 2). It is impossible to determine whether the specimens in the collection are cotypes or heautotypes, for there is no way of telling whether they were of the original series or whether they were among the supplementary specimens collected by Schrammen after he wrote his description of the species.

18321. ***Cycloclema compressa*** (Hinde) (p. 105).

PLESIOTYPES

This species was described as *Ragadinia compressa* by Hinde (1883, p. 82) from the Upper Chalk of Oare, and Huish, Wiltshire (Pl. xix, figs. 3, 3a). Schrammen considers that this species cannot be regarded as a *Rhagadinia* "because the arms of the tetracles around the osculum have circular elevations which the tetracles in *Rhagadinia* never possess" (1910, p. 107). Schrammen has found the species at Misburg and Oberg in the Quadratenkreide and Mucronatenkreide and has figured a specimen from the Quadratenkreide of Oberg (Pl. v, figs. 3, 4; skeletal elements, text plate vi, fig. 5).

18322. ***Procallapsis clavata*** (Hinde) (p. 108).

PLESIOTYPE

This species was described by Hinde as *Ragadinia clavata* from the Upper Chalk of Wiltshire (1883, p. 84, Pl. xix, figs. 4, 4a, 4b, 4c), the cotypes being in the Jermyn-Street Museum. In 1901 Schrammen (p. 7) erected the genus *Procallapsis*, with the species *cylindrica* as genoholotype. This species comes from the Quadratenkreide of Oberg and the Mucronatenkreide of Misburg, the figured holotype coming from the latter (Pl. i, fig. 5) and being now in the Roemer Museum. By the time of publication of the Monograph Schrammen had concluded that his species *P. cylindrica* was the same as Hinde's *Ragadinia clavata*, for which reason he accepted Hinde's specific name. Since, however,

the tetracles in the central region are furnished with collar-like elevations such as never occur in *Ragadinia*, Schrammen did not follow Hinde in the generic designation.

18323. *Procaliapsis cretacea* Schrammen (p. 108).

COTYPE

Schrammen in 1901 described, without illustrating, *Procaliapsis cretacea* from the Quadratenkreide of Misburg. The type specimen is now in the Roemer Museum. Since Schrammen did not figure the specimen upon which he based his very brief (10 word) description of the species and since he did not state how many specimens he had, there is some doubt as to whether the protolog is to be considered as based on a holotype or cotypes. However, I have assumed that he had several specimens for he sent three to the Museum in 1903 and these were in all probability from the original series. Furthermore, since he neither figured nor designated a holotype it is unsafe to assume that he had one and I, therefore, am calling the specimens in the collection cotypes. That they are by no chance heautotypes is apparent from the fact that Schrammen sent them in the earlier collection to the Museum and also because in his Monograph he states that he has only two specimens upon which to base his fuller description.

In 1910 Schrammen figured some spicules from a specimen from the Quadraten of Oberg (text plate vi, fig. 2).

18324. *Astrocladia subramosa* (Roemer) (p. 111).

HOMEOTYPE

This species was described by Roemer in 1864 (p. 54, Pl. xix, fig. 3) as *Astrospongia subramosa*, from the Quadraten marl of Sudmerberg [not "*Astrospongia* as given by Schrammen, 1910, p. 111]. Zittel in 1878 ('Studien,' II, p. 147) erected the genus *Astrocladia* for parts of *Astrospongia* and of several other genera. Griepenkerl reports the rare occurrence of this species in the Upper Quadraten of Glentorf (1888-1889, pp. 21, 22). Schrammen (1910, p. 111) has added Oberg and Misburg to localities already known and has figured two specimens from the Mucronatenkreide of Misburg (Pl. vi, figs. 4, 5, text plate vi, fig. 9).

18325. *Plinthosella squamosa* von Zittel (p. 114).

PLESIOTYPE

This species was described by Zittel in 1878 ('Studien,' II, p. 153, Pl. ii, fig. 10, Pl. x, fig. 5) from the Quadratenkreide of Ahlten and Linden in Hanover. In 1880 Hinde ('Sponge Spicules,' p. 56) described spicules of this genus and figured them (Pl. iv, figs. 35-46) from the Horstead flint nodule in the Upper Cretaceous of Norfolk, England. In

1883 (p. 85) he recorded the species from the Upper Chalk of the south of England, from Wiltshire and from Horstead, Norfolk. Počta reports (1884, p. 42) the finding in the Weissenberg beds of Renčov, Bohemia, fragments of a specimen which seems to fit Zittel's description. Schrammen (1910, pp. 114, 115) adds to the previous localities Oberg, Misburg, and Adenstedt and the higher horizon of the Mucronatenkreide. Počta claims that he has found in the sponge nodules of the Weissenberger Schichten, fragments of tetracloones which he supposes to be "those of *Plinthosella squamosa*"; this species, he adds, is not known to him from the equivalent beds of northwest Germany. Judging from the usual occurrence of this species, it would be classed as one of the smallest of the sponges, for it is about the size of a hazel-nut commonly, but at times it reaches a considerably greater size, Schrammen recording that he has seen one 3 cm. thick and 11 cm. broad. He has figured three specimens from the Quadratenkreide of Oberg (Pl. vi, figs. 7, 8, 9; skeletal elements, text plate vi, fig. 11).

18326. *Dactylotus micropelta* Schrammen (p. 115).

COTYPE

This species was described by Schrammen from material from Oberg and Misburg, specimens from both localities having been figured (1910, Pl. vi, figs. 1-3; skeletal elements, text plate vi, fig. 8). There is thus no holotype and the nine specimens studied by Schrammen are all cotypes, one of those from Oberg being in the Museum Collection.

18327. *Geodiopsis microthrinax* Schrammen (p. 118). PARATYPE (Spicules)

Schrammen based his description of this species upon two specimens, one from the Mucronatenkreide of Misburg, one from the Quadratenkreide of Oberg (1910, p. 118). He gave no figure of an entire specimen of which, judging from the description, none is known, since only the skeletal elements are described and figured. The protograph is of spicules from the Quadratenkreide of Oberg (*loc. cit.*, text plate i, fig. 8). In the Museum Collection there is only a bottle of spicules.

18328. *Ophiraphidites cretaceus* von Zittel (p. 120).

In 1879 Zittel ('Studien,' III, p. 8) described this species from a specimen which had come from the Quadratenkreide of Linden near Hanover (protograph *loc. cit.*, Pl. xi, fig. 2), and which was in the Museum of the University of Göttingen. As Schrammen points out, the holotype and figured specimen of Zittel's description is only the frag-

ment of a stem, and while Schrammen has many similar specimens he is uncertain to what genus or species they belong (1910, p. 120). One such specimen is in the American Museum Collection.

18329. *Ophiraphidites annulatus* Schrammen (p. 120). PARATYPE

The description of this species is based upon eight specimens examined by Schrammen coming from the Cuvieri Pläner of Heere and from the Quadratenkreide of Heere and Oberg. The figured holotype is from the latter locality (1910, p. 120, Pl. xiv, fig. 9; skeletal elements, text plate VII, fig. 6). In the Museum Collection are two small broken fragments in a bottle.

18330. *Ophiraphidites cylindricus* Schrammen (p. 121). COTYPE OR
HEAUTOTYPE

This species was described by Schrammen in 1899 (p. 5) from the Quadratenkreide of Oberg and Misburg and the Mucronatenkreide of Misburg at which time he figured a specimen from the Quadratenkreide of Oberg and one from the Quadratenkreide of Misburg (Pl. I, figs. 2, 3). When he published his Monograph Schrammen figured two other very beautiful specimens from the Quadratenkreide of Oberg (1910, p. 121, Pl. xiv, fig. 7, Pl. xvii, fig. 7), but the specimen in the collection is not one of those figured.

18331. *Ophiraphidites infundibuliformis* Schrammen (p. 121).
COTYPE OR HEAUTOTYPE

This species was described in 1899 by Schrammen (p. 5) from the Quadratenkreide of Oberg and Misburg, both of the figured cotypes coming from the Quadratenkreide of Misburg (*loc. cit.*, Pl. I, fig. 1, Pl. II, fig. 6). In 1910 Schrammen (p. 121) more fully described the species and figured a specimen from the Quadratenkreide of Oberg (Pl. xiv, fig. 7, text plate VII, fig. 5).

18332. *Ophiraphidites tuberosus* Schrammen (p. 124). PARATYPE OR
HEAUTOTYPE (Spicules)

This species was described from the Quadratenkreide of Oberg in 1899 (p. 5), the figured holotype being from that horizon and locality (Pl. II, fig. 5). Subsequently Schrammen found that the species also occurred in the Mucronatenkreide at Misburg and in 1910 he further described this form and figured another specimen from the Quadratenkreide of Oberg (1910, p. 124, Pl. xvii, fig. 8).

18333. *Cephaloraphidites milleporatus* Schrammen (p. 124). **HOLOTYPE**
(Spicules)

This species was described by Schrammen from the Quadratenkreide of Oberg in 1899 (p. 9), two specimens having been found of which one was figured (*loc. cit.*, Pl. II, fig. 4). In his Monograph (pp. 124, 125) Schrammen states that there is only a single specimen, apparently having found that the other one belonged to another species. All that there is in the Museum Collection is a bottle with a few spicules in it. They presumably came from the holotype.

18334. *Cephaloraphidites cavernosus* Schrammen (p. 125). **HOLOTYPE**
(Spicules)

This species was described by Schrammen from a fragment from the Quadratenkreide of Oberg (1899, p. 6) and the only figure that he gave was one of the spicules (Pl. III, fig. 4); subsequently he gave another illustration of the skeletal elements (1910, text plate VII, fig. 2). The holotype is now in the Hildesheim Museum and Schrammen has not succeeded in finding any other specimens (1910, p. 125). The few spicules in the collection must have come from the holotype.

18335. *Alloioraphium spongiosum* Schrammen (p. 126). **METATYPE**

In 1901 Schrammen (p. 17) described the new genus *Heteroraphidites* with the sole species and genoholotype *H. spongiosus*, from the Quadratenkreide of Oberg, the holotype being in the Roemer Museum (Pl. III, fig. 5, Pl. V, fig. 9). In 1910 Schrammen changed the generic name *Heteroraphidites* to *Alloioraphium* (the former thus becoming a synonym), because Ridley and Dendy had already used a name of similar sound in another family (i. e., *Heteroraphidæ*). *H. spongiosum* becomes, then, the genoholotype of *Alloioraphium* (1910, p. 126, text plate VII, fig. 4). Although Schrammen stated that the species was still in 1910 represented by only a single specimen, yet there is a specimen in the American Museum Collection labelled by him. This is not, however, the figured holotype which is in the Roemer Museum. Schrammen must therefore have overlooked the specimen sent to The American Museum of Natural History, and since it was not used by him in the literature it must be considered only a *metatype*, coming as it does from the type locality and horizon and having been identified by the nomenclator.

18336. *Polytretia seriatopora* Schrammen (p. 126). **COTYPE** (Spicules)

Schrammen based his description of this species (1910, p. 126) upon two specimens from the Quadratenkreide of Oberg, both of which

cotypes are figured (Pl. xiv, figs. 4-6; skeletal elements, text plate vii, fig. 8). In the Museum Collection is a bottle containing a few spicules which presumably came from one of the cotypes.

18337. **Megaloraphium auriforme** Schrammen (p. 124). COTYPE

This is the genoholotype of Schrammen's monotypic genus *Megaloraphium* and was described by Schrammen in 1910 (p. 27) from six specimens from the Quadratenkreide of Oberg, the three cotypes being figured on Plate xiv, figs. 1-3 (skeletal elements, text plate vii, fig. 7). In the Museum Collection is one specimen, a cotype, but not figured.

18338. **Helobrachium consecatum** Schrammen (p. 128). PARATYPE

This species is the genoholotype and sole species in the genus, and *Helobrachium* is the only genus thus far known in the family Helobrachiidae. (See Schrammen 1910, pp. 127, 128.) Schrammen examined four specimens from the Quadratenkreide of Oberg in making the description, but figured only the skeletal elements (text plate vii, fig. 1).

18339. **Pachycothion giganteum** (Roemer) (p. 130). PLESIOTYPES

See No. 18183.

18340. **Rhizopsis horrida** Schrammen (p. 132). COTYPE

See No. 18215.

18341. **Verruculina tenuis** (Roemer) (p. 136). PLESIOTYPE

See No. 18217.

18342. **Verruculina seriatopora** (Roemer) (p. 141). PLESIOTYPE

Roemer described this species as *Manon seriatoporum* from the upper Kreidemergel of Sudmerberg, near Goslar, Hanover (1841, p. 3) and figured the holotype (Pl. i, fig. 6). In 1864 he placed it in Lamouroux's genus *Chenendopora* without adding to the protolog or figuring any new specimens (1864, p. 43).

In 1878 Zittel made *Manon seriatoporum* the genoholotype of *Verruculina* and figured part of the surface and the skeletal elements from specimens from the Mucronatenkreide of Ahlten (1878c, p. 123, Pl. iv, figs. 1a, b).

Hinde doubtfully referred a fragment of a sponge in the British Museum to *V. seriatopora* (Roemer) and figured some of the spicules

(1883, Pl. III, fig. 4). The specimen came from Zittel's Collection and was from the Upper Chalk of Sudmerberg, the type locality for Roemer's species.

Schrammen gave a further description of *V. serialopora* and a long synonymy in which he included a number of other species. The geological range which he recorded was long, extending from the Scaphites Pläner through the lower Mucronatenkreide. The localities which he listed were Nettlingen, Sudmerberg, Misburg, Oberg, Adenstedt, Boimsdorf, Biewende (1910, pp. 141, 142). He figured a single specimen from the Quadratenkreide of Oberg (Pl. XXI, fig. 1) and some spicules from a specimen from the Mucronatenkreide of Misburg (text plate VIII, fig. 5).

In the Schrammen synonymy of *V. serialopora* are included Roemer's *Manon distans*, described from the upper Kreidemergel of Goslar but not figured (Roemer, 1841, p. 3), and *Verruculina distans* Roemer of Zittel which was generically revised by the latter author without comment or specific description (1878c, p. 123). Since Schrammen had Roemer's types and since there is nothing in the literature but Roemer's brief description, and furthermore, since Roemer himself did not mention the species in his 1864 Monograph, we may feel fairly safe in accepting Schrammen's dictum in the matter.

In 1864 Roemer described, from the Quadratenkreide of the Ihme near Hanover and of Sudmerberg, a sponge which he called *Chenendopora aurita* (1864, p. 43, protograph, Pl. XVI, fig. 2). As a synonym of this species he included *Manon phillipsi* Reuss (1845-1846, p. 77, Pl. XIX, figs. 7, 8, 9) from the Unterer Plänerkalk of Schillinge near Bilin, Bohemia. Pošta has revived *Verruculina phillipsi* (Reuss) to independent rank again and has included under that species *Chenendopora aurita* Roemer, which would be permissible by the laws of priority if it were certain that Roemer's species is the same as the one described by Reuss. This is to be doubted, for Pošta says (1884, p. 22) that *Manon micrommatum* Roemer differs in no essential characteristic from *Verruculina phillipsi* (Reuss). Because of this statement Schrammen has included *V. phillipsi* (Reuss) in the synonymy of *Verruculina micrommata* and not in that of *V. serialopora*. But Schrammen puts Roemer's *Chenendopora aurita* in the synonymy of *V. serialopora* and along with it *Verruculina aurita* Roemer as listed by Zittel (1878c, p. 123). If Schrammen's decision regarding *C. aurita* Roemer be accepted, then all later references to that species are also to be included in the synonymy of *V. serialopora*. Thus, Griepenkerl identified as *Verruculina aurita* (Roemer) a fragment which came from the Quadraten of Glentorf ,

Braunschweig, (1888-1889, p. 16), and Wollemann twice referred to this species as occurring in the Senonian of Gr. and Kl. Biewende, Braunschweig, (1901, p. 5; 1902b, p. 58). Schrammen himself, even, at first considered *V. aurita* as a distinct species and listed it from the Quadraten and Mucronaten of Oberg and Misburg in 1901 (p. 21).

Zittel twice figured a species which he called *Verruculina auriformis* (Roemer) and which he cited from the Quadratenkreide of Linden near Hanover (1880, p. 153, fig. 68; 1895, p. 51, fig. 68). Under what genus Roemer originally described this species, I have been unable to find, for there is no species by that name under *Manon* in 1841 nor under *Chenendopora* in 1864. I have not come across the Roemer reference in any synonymy and Schrammen himself did not know it. The *V. auriformis* figured by Zittel is undoubtedly a *V. seriatopora* for which reason the two Zittel references have been included in the synonymy of the latter species.

Hinde described an abundant form in the Upper Chalk of Flamborough, Yorkshire and of Sudmerberg, Hanover, as *Verruculina plicata* (1883, p. 36, protograph, Pl. iv, figs. 2, 2a, b, c, d). He states that this species is distinguished from *V. seriatopora* (Roemer) "in the absence of a linear arrangement and the smaller size of the oscules, and also by the pores of the under surface" (1883, p. 37). However, in his description of *V. seriatopora*, he notes that the oscules (i. e., postica) are only "partly disposed" in linear arrangement, while this feature of linearity was not mentioned in the protolog nor yet in Schrammen's amplified description. Therefore, the arrangement of the postica in lines seems not to be an essential characteristic of *V. seriatopora*. Hinde lays great stress upon the presence of the "thick-set minute pores, 0.3 mm. each in width" on the outer surface of the wall in *V. plicata*. In his notes on *V. seriatopora* he states that the specimen in the British Museum is "not sufficiently free from the matrix to show if pores are present or not" (1883, p. 36). As a matter of fact, fine pores (ostia) are present on the outer surface of *V. seriatopora*, as is brought out by Schrammen in his description of the species. From these considerations, it is apparent that the very characteristics mentioned by Hinde as constituting distinguishing features of *V. plicata* are actually diagnostic of *V. seriatopora*, for which reason Schrammen was justified in placing the former in the synonymy of the latter.

18343. *Verruculina cupula* Schrammen (p. 142).

COTYPES

The species name *cupula* is proposed by Schrammen for the form designated by Phillips *Spongia*, later *Chenendopora marginata* and

credited by several authors to him. Michelin described from several localities in France a form which he called *Chenendopora marginata* (1840-1847, p. 129) and he figured the holotype (Pl. xxviii, fig. 7). He considered *Spongia marginata* Phillips as synonymous with his species, but did not give Phillips the credit for the specific name, a thing which he was not required to do, since Phillips had not described the species and had given only a very sketchy illustration of it. Roemer accepted Michelin's nomenclature and identified specimens from the Quadratenkreide of Peine, Hanover as *Chenendopora marginata* (1864, p. 42). Zittel later placed this species in his genus *Verruculina* (1878c, II, p. 123) and Griepenkerl (1888-1889, p. 16), Wollemaun (1901, p. 4) and, in his early work, Schrammen (1901, p. 21) followed Zittel in this revision. It was not until 1910 that Schrammen proposed the name *cupula* for this species, the *marginata* of authors (p. 142). This he did because he found that this species was, as Zittel stated, a *Verruculina* and yet it did not correspond to the forms designated *Spongia marginata* by Phillips which is also a *Verruculina*. It was necessary, therefore, for Schrammen to assign a new name to the German forms, for which reason he proposed the name *cupula* which is to be used *not* for Phillips' *Spongia marginata*, but for the *Chenendopora marginata* of Roemer and the *Verruculina marginata* of Zittel, Griepenkerl, Wollemaun, Schrammen (1901) *et al.* The specimen in The American Museum of Natural History is unusually fine, showing a large number of the "roots," while the arrangement of the ostia is clearly visible and the large elevated postica may be seen on the inside.

Schrammen records this species from Misburg and Oberg from the Quadraten and the lower Mucronatenkreide. Since he does not give any illustrations or select a holotype, the eight specimens which he examined, of which two are in the collection, are all cotypes. They are plesiotypes of Roemer's *Chenendopora marginata*.

18344. ***Scytalia radiformis*** (Phillips) (p. 151).

PLESIOTYPES

This species was described by Phillips in the first edition of the *Geology of Yorkshire* (1829) as *Spongia radiformis*; in the third edition (1874) the generic name was changed to *Hippalimus* in acceptance of the revision made by D'Orbigny (1850, 'Prodrome,' II, p. 286). Zittel in 1878 ('Studien,' II, p. 128) placed the species under his genus *Scytalia*. Hinde in his Catalogue (p. 44) accepts Zittel's revision and figures a specimen (Pl. vi, figs. 4, 4a, b) from the Upper Chalk of Flamborough where this species "appears to be common."

In 1864 Roemer described and figured a species from the Cuvierkreide of Vorberg near Steinlah and from the Quadratenkreide between Sottmar and Gr. Biewende calling the form *Eudea annulata* (1864, p. 26, Pl. xi, fig. 2). Zittel placed this species in his genus *Scytalia* (1878c, p. 128, Pl. v, fig. 4) and Hinde, accepting the generic revision, went one step further and included *S. annulata* under *S. radiformis*, without, however, stating his reasons. Wollemann in 1901, either ignorant of or ignoring Hinde's revision, identifies specimens as *Scytalia annulata* from Gr. and Kl. Biewende (1901, p. 5). Schrammen correctly calls the species *Scytalia radiformis* and lists Misburg, Oberg, and Adenstedt among the new localities (1910, p. 151) figuring a specimen from the Quadratenkreide of Oberg (Pl. xxi, fig. 2).

18345. *Leiochonia cryptopora* Schrammen (p. 160).

COTYPE OR
HEAUTOTYPE

This species was described by Schrammen in 1901 (p. 16) for certain sponges from the Quadraten of Misburg and Oberg and the Mucronatenkreide of Misburg. The protograph is the figure of a single spicule, a rhizoclone (1901, Pl. v, fig. 6) which Schrammen states is now in the Roemer Museum. From the protolog it is evident that he had entire or at least fragmentary specimens, but at the time he figured none. In his Monograph Schrammen gives the first figures of the species (Pl. xxi, figs. 4, 5), these being of a specimen from Oberg. Schrammen includes in his synonymy, though with a question, Courtiller's species *Platyspongia discus*, which had been briefly described from the Senonian of Saumur in Maine-et-Loire, and figured (Courtiller, 1859, p. 139, Pl. xxxviii, fig. 1).

18346. *Chonella tenuis* (Roemer) (p. 161).

PLESIO TYPES

This species was described by Roemer (1864, p. 51, Pl. xvii, fig. 7) as *Cupulospongia tenuis* from the Quadratenkreide of the Ihme in Hanover. Zittel (1878c, 'Studien,' II, p. 116) proposed the name *Chonella* for a part of D'Orbigny's *Cupulospongia* and for parts of a large number of other genera and included herein Roemer's species of *tenuis*. Hinde (1883, p. 31) gives the distribution as in the Upper Chalk of Sudmerberg, Biewende and Brunswick. To these localities Schrammen (1910, p. 161) adds Linden, Misburg, Oberg, Nettlingen, and Adenstedt, figuring a specimen from the Quadratenkreide of Oberg (Pl. xxi, fig. 6). Though widespread and having a great geological range—from the Scaphites beds through the Mucronatenkreide—the species appears not

to be abundant, for Schrammen has examined only eight specimens. There are two in the Museum Collection from Misburg, one of which shows the skeletal elements on the surface in great perfection.

18347. **Chonella auriformis** (Roemer) (p. 161).

HOMOEOTYPE

See No. 18223.

18348. Cf. **Coscinostoma auricula** Schrammen (p. 163).

Schrammen described this species in 1910 (p. 163, Pl. XXI, fig. 8) from four specimens from the Mucronatenkreide of Misburg. This specimen from Oberg is identified only *confer* and is included with the type material solely because it is the only representative of the genus from Oberg. (For fuller notes see No. 18525).

18349. **Seliscothon planum** (Phillips) (p. 163).

PLESIOTYPE

See No. 18224.

18350. **Seliscothon mantelli** (Goldfuss) (p. 165).

PLESIOTYPES

Goldfuss described this species from the Green Chalk of Coesfeld, Westphalia, in 1826 ('Petrefacta Germaniæ,' p. 219, Pl. LXV, fig. 5) calling it *Scyphia mantelli*. D'Orbigny placed the species in his genus *Cupulospongia*, citing it from Goslar and Coesfeld. (Number 1528 in D'Orbigny's 'Prodrome de Paléontologie,' 1850, p. 288). Roemer (1864, p. 50, Pl. XVIII, fig. 6) mentions and figures a specimen from Sudmerberg, calling it *Cupulospongia mantelli*. Quenstedt (p. 375) reverts to the original designation by Goldfuss and reports *Scyphia mantelli* from "Schweinsberge" where the same sandy facies of the Upper Cretaceous is developed as at Sudmerberg. In 1880 Zittel ('Studien,' II, p. 117) proposed the name *Seliscothon* for *Scyphia* of Goldfuss and parts of genera of other authors. Wollemaann ('Senon von Biewende,' 1900, p. 4) has identified two broken specimens from Grosse Biewende as *Seliscothon roemerii* (Pomel).

18351. **Regadrella petri-jacobi** Schrammen (p. 208).

COTTYPES

Schrammen founded this species upon six specimens examined by him from the Quadratenkreide of Oberg (1910, p. 208). Of the six specimens he figured four (Pl. XXVII, figs. 9-11, Pl. XXXI, fig. 2; skeletal elements, text plate XI, fig. 4) apparently failing to figure only the two specimens in the Museum Collection.

- 18352.
- Farrea clarkii***
- Schrammen (p. 120).

COTYPE

This species was described by Schrammen in 1910 from four specimens from the Quadratenkreide of Oberg. Three of these he figured (Pl. xxviii, figs. 5, 6, 7) and the fourth is in the American Museum Collection.

- 18353.
- Farrea halli***
- Schrammen (p. 210).

COTYPES

Schrammen described this species from three specimens from the Quadratenkreide of Oberg in 1910 and figured two of the specimens (Pl. xxviii, fig. 4; Pl. xl, fig. 9; skeletal elements, Pl. xliv, fig. 5, text plate xix, fig. 10). In the American Museum Collection is one fragmentary specimen and there is also a bottle containing three broken pieces.

- 18354.
- Eurete rauffi***
- Schrammen (p. 211).

COTYPE

This species was described by Schrammen in 1910 from six specimens from the Quadratenkreide of Oberg. He figured two of the cotypes (Pl. xxviii, figs. 8, 9). The specimen in the Museum Collection being very similar to, but not the one illustrated in, Fig. 9. The skeletal elements Schrammen illustrated on Pl. xliv, figs. 3, 4 and on text plate xii, fig. 7.

- 18355.
- Periphragella plicata***
- Schrammen (p. 214).

HEAUTOTYPES

In 1902 Schrammen founded the genus *Proeurete* with the genoholotype and sole species *P. plicata* from the Quadratenkreide of Oberg (p. 22). The species was founded upon a single specimen, now in the Roemer Museum, which was figured by Schrammen at the time of description (1902, Pl. i, fig. 6). In 1910 (p. 214) Schrammen, without stating his reason, places the species *plicata* under Marshall's genus *Periphragella*, thus depriving the monotypic *Proeurete* of its genotype and leaving it a *nomen nudum*. He figures other specimens (Pl. xxv, figs. 3 and 4; skeletal elements, Pl. xliv, figs. 1, 2, and text plate xii, figs. 2, 3) stating that he has examined eleven altogether. While there are five excellent specimens in the Museum Collection and one bottle of fragments, not one is figured, although several are better than those illustrated by Schrammen.

- 18356.
- Chonelasma hindii***
- Schrammen (p. 217).

PARATYPE

This species was described by Schrammen in 1910 from four specimens from the Quadratenkreide of Oberg, one of which he figured (Pl.

xxviii, figs. 1, 2; skeletal elements, Pl. XLII, fig. 3, text plate XII, fig. 1). In the American Museum Collection is a bottle full of fragments.

18357. **Aphrocallistes alveolites** (Roemer) (p. 219).

PLESIOTYPES

From Peine, Hanover, Roemer described and figured *Scyphia alveolites* (1841, p. 8, Pl. III, fig. 6). Zittel in the first of his "Studies" listed Roemer's species under Gray's genus *Aphrocallistes* (1878b, I, p. 49). Hinde identified, not without some question, two small sponge fragments from the Upper Chalk of the South of England as *A. alveolites* (1883, p. 106) and Wollemaann identified, as the same species, forms coming from the Senonian of Kl. Biewende, Braunschweig, (1901, p. 8, 1902b, p. 58) and from the *Heteroceras* zone of the Mucronatenkreide at Zeltberg, near Lüneberg, Hanover (1902a, p. 8). Schrammen has collected this species from the Mucronatenkreide of Misburg and the Quadratenkreide of Oberg, figuring four from the latter locality (1910, p. 219, Pl. xxv, figs. 8, 9, 10; Pl. xxxi, fig. 3; skeletal elements, text plate XI, fig. 5). There are nine specimens in the Museum Collection, but not one is figured.

18358. **Aphrocallistes cylindrodactylus** Schrammen (p. 220). PARATYPES

This species was described by Schrammen in 1910 from four specimens coming from the Quadratenkreide and Mucronatenkreide of Oberg and Misburg, the figured holotype being from the latter locality (1910, text fig. 1). There are two specimens in the collection, but neither is the figured one.

18359. **Hexactinella angustata** Schrammen (p. 223).

COTTYPES OR
HEAUTOTYPES

In 1902 (p. 26) Schrammen described a species *angustata* as the genoholotype of *Polyopesia*. The holotype is a small specimen from the Quadratenkreide of Oberg, figured on Plate II, fig. 1, and is now in the Roemer Museum. At the same time Schrammen described a second species *Polyopesia radiciformis* from the Mucronatenkreide of Misburg (p. 26) and figured it on Plate III, fig. 4. When he came to publish his Monograph he placed both of these species under Carter's genus *Hexactinella* (1910, p. 223, Pl. xxvi, figs. 6, 7, 10; text plate XI, fig. 8) which he emended. In his synonymy of *Hexactinella angustata* he included *P. radiciformis*, thus leaving *Polyopesia* a *nomen nudum*. He fails to state his reason for abandoning the generic name *Polyopesia* but it must be noted that in 1902 his determinations and classification

were rather of a provisional nature and that he was then in doubt about which tribe to place the family Craticularidæ Rauff in, this being the family to which he had assigned the genus *Polyopesia*. In 1910 he made use of F. E. Schulze's family Tretocalycidæ under which he separated two genera by restriction, *Hexactinella* of Carter, and Schulze's *Tretodictium*, the former being characterized by anastomosing tubes with irregular canals, the latter by a more or less regularly developed canal system. In 1910 Schrammen was able to extend the geological range of the species down as low as the Cuvieri Pläner, because of occurrences in Heere. He figured three specimens from the Quadratenkreide of Oberg (Pl. xxvi, figs. 6, 7, 10) and the skeletal elements (text plate xi, fig. 8).

18360. *Hexactinella lævis* Schrammen (p. 224).

PARATYPES

From four specimens from the Quadratenkreide of Oberg Schrammen described this species in 1910, and figured one of them (Pl. xxvi, fig. 5; skeletal elements, Pl. xlii, fig. 5). There are three specimens in the Museum Collection, probably the three paratypes which were not figured.

18361. *Auloplax spongiosus* Schrammen (p. 230).

COTYPE (?)

Schrammen gave this name in 1910 to two specimens from the Quadratenkreide of Oberg, both of which he figured natural size and twice enlarged (*loc. cit.*, Pl. xxix, figs. 7, 8, 9, 10; skeletal elements, text plate ix, fig. 10). In the Museum Collection is a bottle containing two small fragments and some spicules, presumably from one of the cotypes.

18362. *Stereochlamis præcissa* Schrammen (p. 231).

PARATYPE

Stereochlamis præcissa is one of three genosyntypes described by Schrammen in 1910 (p. 231). It comes from the Kalkmergel of the Quadratenkreide of Oberg where Schrammen had collected two specimens, one of which he figured natural size and twice enlarged (Pl. xxix, figs. 5 and 6; skeletal elements, text plate x, fig. 10). The specimen in the collection is a fragment of the sponge wall showing inner and outer surfaces. The ostia are markedly aligned in vertical rows not obscurely so, as Schrammen states (*loc. cit.*, p. 231). Furthermore, the ostia and postica are much smaller than the dimensions given by Schrammen indicate, while the curvature of the fragment of the wall suggests a much smaller individual than is figured in the protograph. One would hesitate to call the specimen in the collection *Stereochlamis præcissa*

did it not bear Schrammen's label; certainly one could not identify it as such from a study of the protolog and protograph. Presumably, the specimen in the Museum is a paratype, since it is not the holotype and since Schrammen stated that he had examined only two specimens.

18363. **Craticularia virgatula** Schrammen (p. 234).

PARATYPES OR
METATYPES

Schrammen based his description of this species upon three specimens from the Quadratenkreide of Oberg (1910, p. 234), one of which he figured (Pl. xxx, fig. 1; skeletal elements, Pl. XLIII, fig. 3, text plate XI, fig. 9). In the Museum Collection are four specimens which Schrammen either had at the time he wrote his description and which he overlooked or else he collected them subsequently and they are simply metatypes.

18364. **Leptophragma murchisoni** Goldfuss (p. 235).

PLESIOTYPE

See No. 18532.

18365. **Leptophragma murchisoni** Goldfuss var. *minor* Schrammen.

HOLOTYPE

One of the three specimens of *Leptophragma murchisoni* in the Museum Collection is labelled variety *minor*. This belongs to the group called by Schrammen cf. *Leptophragma murchisoni*, a designation which he used for certain small forms which he was in doubt whether to consider as a small variety of *L. murchisoni* or as young stages of the species. It is here proposed to put in print the name which Schrammen applied to the species in labelling the specimen. (This specimen, thus, is a chirotype which is now being raised to the rank of a holotype.) He figured one of these young forms twice enlarged on Pl. xxxii (figs. 1, 2) from the Quadratenkreide of Oberg.

18366. **Leptophragma pusillum** Schrammen (p. 236).

PARATYPES OR
HEAUTOTYPES

This species is one of the smallest Hexactinellas occurring in Hanover and was described by Schrammen in 1902 (p. 22) from the Quadratenkreide of Oberg and Misburg, the holotype, figured on Pl. III, fig. 6, being now in the Roemer Museum. In 1910 he figured two more specimens (Pl. xxxii, figs. 6, 7 and the skeletal elements, Pl. XLIII, fig. 1, text plate IX, fig. 2) and further described the species (p. 236). It is confined to the Quadratenkreide of Oberg. The three

specimens in the American Museum Collection are either paratypes if belonging to the original series, or heautotypes if from the material subsequently found by Schrammen and used in amplifying his description in 1910.

18367. **Leptophragma micropora** Schrammen (p. 237). COTYPE

This is a species of wide geological range occurring in the clays of the Granulatenkreide and up through the Mucronatenkreide. Schrammen lists its occurrence at Broitzem near Braunschweig, whence one of the figured cotypes came (1910, Pl. xxxii, fig. 5), from Misburg, Oberg (whence the second figured cotype, *loc. cit.*, Pl. xxxii, fig. 4) and Ahlten. He described the species in 1910 (Monograph, p. 237).

18368. **Pleurostoma radiata** Roemer (p. 238). PLESIOTYPE

From the Untere Kreide of Theidensen, near Peine, Hanover, Roemer described this species in 1841 (p. 5) and figured the holotype (Pl. i, fig. 11). Zittel listed it in the first of his 'Studies' (1878*b*, p. 48) and Hinde recorded the presence in T. Smith's collection of representatives of this species from the Upper Chalk of the South of England (1883, p. 103). Griepenkerl found in the Quadraten of Boimstorf, Braunschweig, one specimen which he identified with Roemer's species (1888-1889, p. 22). Schrammen has found this form in the Quadratenkreide of Misburg and Oberg, from the latter of which he has figured two specimens (1910, p. 238, Pl. xxxiii, figs. 1-3).

18369. **Pleurostoma dichotoma** Schrammen (p. 239). IDIOTYPE

In 1902 Schrammen described the genus *Typhlopleura* with *T. dichotoma* as the genoholotype and sole species (1902, p. 24). The holotype of the species was figured by Schrammen (Pl. i, fig. 3) and came from the Mucronatenkreide of Misburg. It is now in the Roemer Museum. In his Monograph Schrammen practically repeated the protolog (1910, p. 239) and he reproduced the protograph, placing the species in Roemer's genus *Pleurostoma* and thereby leaving *Typhlopleura* a *nomen nudum*. There is in the collection a specimen from a purchase made in 1903, and it is labelled *Typhlopleura dichotoma*. It is rather surprising that Schrammen made no record in print of the occurrence of the form in the Quadratenkreide and at Oberg, but he expressly states that he had examined only three specimens from the Quadratenkreide of Oberg. The single specimen in the collection is, therefore, to be regarded as an idio-type.

18370. *Guettardia stümpeli* Schrammen (p. 240).PARATYPES OR
HEAUTOTYPES

The holotype of this species, now in the Roemer Museum, is a specimen from the Quadratenkreide of Oberg described by Schrammen in 1902 (p. 22) and figured on Plate iv, fig. 3. At that time he mentioned its occurrence at Misburg also in the Quadratenkreide. In his Monograph (1910, pp. 240-41), however, Schrammen failed to give Misburg among the localities for this species, but figured another much more complete specimen than the holotype from the Quadratenkreide of Oberg (Pl. xxx, fig. 9; skeletal elements, text plate ix, fig. 3). The specimens in the collection are paratypes if from the original series, heautotypes if from the subsequent collections by Schrammen.

18371. *Andreæa hexagonalis* Schrammen (p. 243).

HEAUTOTYPES

This species is the genoholotype of, and sole species in the genus *Andreæa*¹ described by Schrammen in 1902 (p. 25). At that time he had a single specimen from the Quadratenkreide of Misburg which he figured (*loc. cit.*, Pl. i, fig. 4) and which is now in the Roemer Museum. By 1910 he had found three more specimens, one of which from Oberg, he figured (Pl. xxv, figs. 2 and 3; skeletal elements, text plate xi, fig. 7). The protograph is reproduced on Pl. xxv in fig. 4.

18372. *Callibrochis senonensis* Schrammen (p. 246).

HEAUTOTYPE

In 1902 (p. 19) Schrammen erected the new family Eubrochidæ, under the tribe Hexasterophora, with the sole genus *Eubrochis* Schrammen containing the single species, the genoholotype, *E. senonica* Schrammen, which in turn was founded upon a single specimen from the Quadratenkreide of Oberg, now in the Roemer Museum. In 1910 (Monograph, p. 246) Schrammen, having found that the generic name *Eubrochis* had already been used, proposed *Callibrochis* and changed the family name Eubrochidæ to Callibrochidæ so that *senonica* became the genoholotype for *Callibrochis*. By 1910 he had examined two more specimens from the Quadratenkreide of Oberg, one of which he figures (Pl. xxvii, fig. 1; skeletal elements, Pl. xli, fig. 6, text plate x, figs. 2 and 3). The specimen in the Museum Collection consists of two small fragments which are from a heautotype.

¹This generic name has been used for a genus of moss and the family name *Andreæade* proposed by Schrammen has been used for a family of mosses. Since the names are employed in groups so distinct as mosses and sponges it seems unnecessary to propose new generic and family names, although the strictest usage in nomenclature would require such a procedure.

18373. **Wollemannia araneosa** Schrammen (p. 247).

PARATYPES

In 1910 Schrammen (p. 247) described the new genus *Wollemannia* with *araneosa* as the genoholotype and only species of the genus. He had examined three specimens from the Quadratenkreide of Oberg and had figured one of them (Pl. xxvii, fig. 2; skeletal elements, Pl. xli, fig. 5, text plate x, figs. 4, 5, 6). There are two specimens in the Museum Collection, neither of which is figured, so that they are the two paratypes.

18374. **Pleurochorium schulzii** Schrammen (p. 251).

COTYPE

This is the genoholotype and only species of *Pleurochorium* Schrammen, described in 1910 (p. 251) from seven specimens from the Quadratenkreide of Oberg, three of which are figured (*loc. cit.*, Pl. xxvii, figs. 3, 4, 5; skeletal elements, Pl. xli, figs. 1, 2, text plate x, fig. 8).

18375. **Ptychodesia papillata** Schrammen (p. 252).

PARATYPES

In 1910 Schrammen described the new family Ptychodesidæ for Cretacic and living forms, with the sole genus *Ptychodesia* and the genoholotype *P. papillata* (p. 252). The description was based upon four specimens examined by Schrammen from the Quadratenkreide of Oberg, one of which, the holotype, is figured (*loc. cit.*, Pl. xxx, fig. 4; skeletal elements, Pl. xliii, fig. 5, text plate xi, fig. 2). The two specimens in the collection are paratypes.

18376. **Polystigmatium striato-punctatum** Schrammen (p. 254).

METATYPES

This species is the genoholotype of *Polystigmatium* and the only species thus far known in it. It was described by Schrammen in 1910 (p. 254) from two specimens from the Quadratenkreide of Oberg, both of which are figured (*loc. cit.*, Pl. xxxii, figs. 8, 9; skeletal elements, Pl. xlii, fig. 2, text plate x, fig. 11). Strangely enough there are four specimens in the Museum Collection, some of which are as good as, if not better than, the figured ones, but none of them is figured, yet Schrammen states that he had examined only two specimens; therefore the four in the Museum are metatypes.

18377. **Stichmaptys alatus** Schrammen (p. 255).

METATYPE

This species is the genoholotype of, and sole species in, the genus *Stichmaptys* described by Schrammen in 1910 (p. 255) from two specimens from the Quadratenkreide of Oberg, both of which he figured (Pl.

xxx, figs. 2, 3; skeletal elements, Pl. XLIII, fig. 8, text plate IX, fig. 8). There is one specimen in the Museum Collection and, since it is not one of the two figured cotypes, it is a metatype.

18378. *Balantionella elegans* Schrammen (p. 261).

COTYPE OR
HEAUTOTYPE

In 1902 Schrammen (p. 23) erected the genus *Balantionella* for the single species and genoholotype *B. elegans* from the Quadratenkreide of Misburg and Oberg. Of the figured cotypes, one is from Misburg (Pl. IV, fig. 1a), two are from Oberg (1b, 1c). These cotypes are in the Roemer Museum. In 1910 Schrammen further described the species (p. 261) and figured the skeletal elements (Pl. XLII, fig. 6, text plate IX, fig. 7). He also reproduced the figures of the cotypes from Oberg. The four fragments in the collection are cotypes if belonging to the original series, but heautotypes if belonging to the supplementary material.

18379. *Ventriculites radiatus* Mantell.

PLESIOTYPE

See No. 18191 for discussion of *V. radiatus*.

18380. *Ventriculites radiatus* Mantell mut. *posterus* Schrammen.

CHIOTYPE

This mutation is represented by two exceptionally perfect specimens of stems and by three small fragments of the wall. The larger of the two stems is 15 cm. in length and 5 cm. in thickness. The ostia are arranged in strikingly unbroken linearity as shown in Fig. 1 on Plate XXXVI in Schrammen's Monograph. The ostia are, however, very much larger than are there indicated, reaching almost the maxima in dimensions given by Schrammen, for they are 5 mm. long and from 1.5 to 2 mm. wide.

The three small fragments show every detail of structure for the inner and outer surface of the wall, the position of the epirhyza and aporhyza and the form of the ostia and postica. In the thinness of wall, smaller size of the ostia and postica, and their arrangement, these fragments fit the description of *Ventriculites radiatus* Mantell var. *minor* Schrammen, described from three specimens from the Quadratenkreide of Oberg and Misburg (Schrammen, 1910, p. 266). It is to be regretted that Schrammen did not figure this variety. The large specimen of the stem labelled var. *posterus* does not fit the description of var. *minor*.

Here, as in the case of the other chiotypes, it seems best to retain Schrammen's manuscript name until future work on the spicules can be done or until more illustrations of Schrammen's holotypes appear in print.

18381. **Ventriculites stellatus** Schrammen (p. 267). HEAUTOTYPE

Schrammen described this species in 1902 (p. 11) from the Quadratenkreide of Misburg, figuring the holotype (Pl. III, fig. 5) which is now in the Roemer Museum. In 1910 he further described the species, reproducing the protograph (Pl. XXXVII, fig. 4), and gave in addition the figure of a specimen from Oberg (Pl. XXXVII, fig. 5) with which, however, the specimen in the American Museum Collection does not agree. It is, therefore, a heautotype.

18382. **Lepidospongia rugosa** Schlüter (p. 269). PLESIOTYPES

This species was named and briefly described by Schlüter, in 1870, when he gave a paper before the Niederrheinische Gesellschaft in Bonn (see Sitzungsberichte of same for 1870, p. 139), and was mentioned again two years later in his longer paper and there figured (1872, p. 27, Pl. I, figs. 1-4). This species has given the name of the zone of *L. rugosa* to the lower Mucronaten beds of Münsterland. Schlüter mentions, as localities where the species is abundant, Coesfeld and Osterwick.

In 1902 (p. 11) Schrammen described the species *Lepidospongia brandesi* for certain forms which he considered differed mainly from *L. rugosa* in their more delicate structure and "in the possession of finer ribs." Also, the two were found at different horizons, *L. brandesi* occurring in the older beds of the Quadratenkreide with *Micraster glyphus* and *Offaster pilula*, while it was unknown to Schrammen in the Mucronatenkreide. On the other hand, *L. rugosa* he thought appeared for the first time in the Hanover Chalk in the boundary beds between the Quadratenkreide and Mucronatenkreide of Adenstedt and extended upward into the Misburg Chalk. He corrected the statement which he had made in a foot-note in his first Roemer Museum paper (1899, p. 3) in which he had stated that he knew *L. rugosa* from the Quadratenkreide of Misburg, accounting for the error as due to a cursory identification of forms as *L. rugosa* which were really *L. brandesi*. The two cotypes of *L. brandesi* are figured (1902, Pl. III, figs. 1, 2) and come from the Quadratenkreide of Misburg. By the time Schrammen published his Monograph he had come to the conclusion that the features which he had previously considered of specific rank were not so in reality and he included *L. brandesi* in his synonymy of *L. rugosa*, stating that the former differed from the latter only "in the thinner walls, finer longitudinal ribs on the outside and smaller siliceous scales on the inside" (p. 269). In the Monograph, Schrammen has given a more complete description of *L. rugosa* and has figured two new specimens from the Quadraten-

kreide of Misburg (Pl. xxxv, figs. 7, 8; skeletal elements, text plate XIII, fig. 2). There are five specimens from the Quadratenkreide of Oberg in the Museum Collection.

18383. **Lepidospongia fragilis** Schrammen (p. 269).

COTYPES OR
HEAUTOTYPES

In 1902 Schrammen erected the genus *Plectodermatium* with the species *P. fragile* as the genoholotype (1902, pp. 12, 13). This he described from the Quadratenkreide of Misburg and Oberg and the Mucronatenkreide of Misburg, figuring the two cotypes on Pl. iv, figs. 4a and b, the first cotype being from the Quadratenkreide of Misburg, the second from the Mucronatenkreide of Misburg, both of which are now in the Roemer Museum. Without stating his reason, Schrammen, in 1910, placed this species under *Lepidospongia* (Monograph, p. 270), the genus *Plectodermatium*, *ipse facto*, becoming a *nomen nudum*. In further illustrating the species he figured only the skeletal elements (Pl. XLV, fig. 6; text plate XIII, fig. 1). The two specimens in the collection may be either cotypes, or heautotypes.

18384. **Rhizopterion solidum** Schrammen (p. 271).

PARATYPES

This species was described by Schrammen in 1910 from eight specimens from the Quadratenkreide of Misburg and Oberg. The figured holotype is from the Quadratenkreide of Oberg (*loc. cit.*, Pl. xxxiv, fig. 6; skeletal elements, text plate XIII, fig. 8, text plate XIV, fig. 8).

18385. **Napæa striata** Schrammen (p. 273). PARATYPES OR HEAUTOTYPES

In 1902 Schrammen made the new genus *Eudictyon* and described from the Quadratenkreide of Misburg and Oberg two species *E. striatum*—the genoholotype and *E. diagonale* ('Hexactinelliden,' pp. 15, 16). The originals are in the Roemer Museum. The holotype of the first species is from the Quadratenkreide of Misburg (*loc. cit.*, Pl. II, fig. 5), that of the second species also from the Quadratenkreide of Misburg (*loc. cit.* Pl. I, fig. 5). By the time that he published his Monograph he had found that the name *Eudictyon* had already been preëmpted; he therefore proposed the new generic name *Napæa* and he furthermore placed both of the former species of *Eudictyon* under *N. striata*, although he fails to give his reasons (1910, p. 273). The holotype of *Eudictyon striatum* becomes the holotype of *Napæa striata*, and the protograph of *E. striatum* becomes the protograph of *N. striata*. The holotype of *E. diagonale* becomes a heautotype of *N. striata*. The five specimens in the collection

are paratypes. He figures two additional specimens coming from the Quadratenkreide of Oberg, Pl. xxxvi, figs. 11, 12, and refigures the holotype of *Eudictyon diagonale* which he states comes from the Quadratenkreide of Oberg, although in 1902 he had said that it came from Misburg.

18386. **Polyblastidium racemosum** (T. Smith) (p. 275). PLESIOTYPES

This species was described by Smith in 1848 as *Brachiolites racemosus* from the Upper Chalk of England. Smith, being more concerned with the classification of the Ventriculitidæ than with their stratigraphic position or geographic distribution, fails to give the locality whence the specimen which he figures and describes came. Roemer under the name *Cephalites ellipticus* in 1864 (p. 7, Pl. iv, fig. 6) described certain specimens from the Quadraten of Oberg. In 1878 Zittel, in the first of his 'Studien' (p. 52), erected the new genus *Polyblastidium* and gave as the genoholotype *P. luxurians* from Linden near Hanover. In describing *P. racemosum* in 1902, Schrammen includes all of the foregoing species under it (p. 275). It is found both at Oberg and Misburg from the Quadraten of the former and the Mucronaten of the latter, and Schrammen figures three specimens from the Quadratenkreide of Oberg (Pl. xxxviii, figs. 8-10).

18387. **Actinocyclus alternans** (Roemer) (p. 277). PLESIOTYPE

In 1841 Roemer described from the Untere Kreide of Peine, Hanover, a sponge which he called *Cæloptychium alternans* (1841, p. 10, figured holotype Pl. iv, fig. 6). Zittel, in the first of his 'Studien,' erected the genus *Marshallia* with *Pleurostoma tortuosum* Roemer and *Cæloptychium alternans* Roemer as two representative species, the former being the genoholotype. This he did after examining Roemer's types of both species (1877, p. 58). Schrammen considered that Roemer's *C. alternans* is generically distinct from *Pleurostoma tortuosum*, for which reason he erected the genus *Actinocyclus* with *A. alternans* as the genoholotype (1910, p. 277) and for this genus he has founded the new family Actinocyclidæ (1910, p. 276). Schrammen's figured cotypes are all from the Quadratenkreide, one from Misburg (1910, Pl. xxix, fig. 1), and two from Oberg (*loc. cit.*, Pl. xxix, figs. 2, 3; skeletal elements, text plate xiv, fig. 14).

18388. **Microblastidium decurrens** Schrammen (p. 279). PARATYPE OR HEAUTOTYPE

Schrammen described this species in 1902 from two specimens from the Quadratenkreide, one from Oberg and one from Misburg (p. 15).

The holotype was a fragment of the wall of a specimen from Oberg (*loc. cit.*, Pl. iv, fig. 5). In his Monograph, Schrammen figured two nearly complete specimens from Oberg (Pl. xxx, fig. 11, Pl. xxxvii, fig. 9; skeletal elements, text plate xv, fig. 15). Since the only locality which he gave in 1910 was Oberg, it is evident that he had come to the conclusion that the specimen from Misburg was not to be placed in this species.

18389. *Sporadiscinia decheni* (Goldfuss) (p. 280).

This species was described by Goldfuss as *Scyphia decheni* from the Green Chalk of Coesfeld, Westphalia (1826, p. 219; protograph, Plate LXV, figs. 6a, b). D'Orbigny placed the species questionably in Lamarck's genus *Ocellaria* (1850, p. 284) and later Roemer called it *Cribrospongia decheni* (1864, p. 12). At this time he made the mistake of considering his former *Scyphia micrommata* a synonym of *Scyphia decheni* Goldfuss. As Schlüter first pointed out, the Goldfuss species was characterized by the diagonal arrangement of the smaller and more oval ostia in contradistinction to the larger indiscriminately situated ostia of *S. micrommata* (Schlüter, 1872, 'Spongitarienbänke,' p. 22). Schlüter accepted Roemer's generic revision and noted the occurrence of the species in the Quadraten Mergel in the zone of *Becksia soekelandi* in Münsterland. In 1877 Zittel emended Pomel's genus *Sporadiscinia* and included in it *Scyphia decheni* Goldfuss (1877, p. 362) and this revision was repeated the next year in the first of his 'Studies' (1878, p. 52). Both Hinde (1883, p. 116) and Schrammen (1910, p. 280) have accepted this generic standing for the species. Schrammen has figured two specimens from the Quadratenkreide of Misburg (*loc. cit.*, Pl. xxxvii, figs. 6, 7) showing clearly the internal and external surface characteristics. His description is the first adequate one which has appeared in print and the first one containing the necessary information about the skeletal elements. The specimens which he used in making his description and which came from the Quadratenkreide of Misburg must be looked upon as plesiomorphic types, but, since he did not mention Oberg in print in his further description, the specimens from that locality are not types. (See also discussion under *Sporadiscinia quenstedti* No. 18392.)

18390. *Sporadiscinia venosa* (Roemer) (p. 281).

PLESIOTYPE

From the Untere Kreide of Peine, Hanover, Roemer described *Scyphia venosa* (1841, p. 8) and figured the holotype (Pl. iii, fig. 4). Roemer later changed the generic name to *Cribrospongia* of D'Orbigny.

adding nothing, however, to the protolog (1864, p. 11). Wolle-
mann gave a somewhat more complete description of the species, placing it in
Pomel's genus *Sporadiscinia* (1902, p. 10), but did not figure any of the
specimens which he had. His collections were from the *Heteroceras*
zone of the Mucronatenkreide of Zeltberg, near Lüneburg, Hanover.
The description given by Schrammen in 1910 based upon Roemer's
types and upon collections from the Quadratenkreide of Misburg and
Oberg is the first strictly scientific description (1910, p. 281). A
figure is given of a specimen from the Quadratenkreide of Misburg
(Pl. xxxviii, fig. 4) and the skeletal elements are illustrated (Pl. xiv,
fig. 18).

18391. *Sporadiscinia micrommata* (Roemer) (p. 281). PLESIOTYPES

Roemer described this species as *Scyphia micrommata* from the
lower Kreidemergel of Coesfeld, Westphalia (1841, p. 7, protograph Pl.
ii, fig. 11). D'Orbigny included the species under his genus *Cupulo-
spongia* (1850, p. 287). On account of an incorrect revision made by
Roemer in 1864, when he considered his *Scyphia micrommata* as a
synonym of *Scyphia decheni* Goldfuss, it is necessary to include the
S. micrommata part of his *S. decheni* in the synonymy. Schlüter, as we
have seen (No. 18390), restored *Scyphia micrommata* as a distinct species.
He placed it in D'Orbigny's genus *Cribrospongia* and reported it from
the zone of *Lepidospongia rugosa* of the Quadraten of Münsterland
(Schlüter, 1872, p. 28). At the same time that Zittel revised *Scyphia
decheni* he also included *S. micrommata* in Pomel's emended genus *Spora-
discinia* (1878c, p. 52; 1877, p. 362). Hinde (1883, p. 116) and Woll-
mann have accepted Zittel's generic revision. Wolle-
mann reported the species from the *Heteroceras* zone of the Mucronatenkreide of Zeltberg,
near Lüneburg, Hanover (1902a, p. 10). Schrammen has added to the
localities already known, Misburg, Oberg, Adenstedt, and Biewende,
and has figured two specimens from the Quadratenkreide of Misburg
(1910, p. 283, Pl. xxxviii, figs. 5, 6). (See further Nos. 18390, 18392.)

18392. *Sporadiscinia quenstedti* Schrammen (p. 282). PARATYPES

From the Green Chalk of Coesfeld, Westphalia, Goldfuss described
the species *Scyphia decheni* (1826, p. 29) figuring the holotype (Pl.
lxv, figs. 6a, b). This species was subsequently placed under various
genera, but is now called *Sporadiscinia decheni* (for details see that
species). Quenstedt identified a fragment which he had obtained from
the Chloritic Chalk of Ahlten as *Scyphia decheni* (1877, p. 454), and

figured his specimen (Pl. cxxxvii, fig. 2). A comparison of the protographs of *Scyphia decheni* Goldfuss and *Scyphia decheni* Goldfuss of Quenstedt reveals the very obvious fact that the ostia in the figure given by Goldfuss are irregular in arrangement and polygonal in outline, whereas those in the illustration given by Quenstedt are rectangular. Primarily on account of this distinction, Schrammen erected the new species *Sporadiscinia quenstedti* for the forms with the rectangular ostia, this being the only species of *Sporadiscinia* with ostia of that shape. Quenstedt's *Scyphia decheni* Goldfuss thus becomes a synonym of *Sporadiscinia quenstedti*, as does also Wollemann's *Sporadiscinia decheni* var. *quadrata* which was described from the *Heteroceras* zone of the Mucronatenkreide of Zeltberg, near Lüneberg, Hanover (Wollemann, 1902a, p. 10). Wollemann's varietal name should not stand because the form is too distinct to be considered a variety of Goldfuss' *Scyphia decheni*. Wollemann ascribes the name *quadrata* to Quenstedt, but I have been unable to find it in that author's work.

Schrammen's protograph is of a specimen from the Quadratenkreide of Misburg (1910, Pl. xxxvii, fig. 8). The species occurs at Oberg and Ahlten, and in the Mucronatenkreide as well as in the Quadratenkreide. Schrammen has examined five specimens, one of which he has figured and three of which (paratypes) are in the American Museum Collection.

18393. ***Leiostracosia brandesi*** Schrammen (p. 288).

PARATYPE

This species was described by Schrammen in 1910 from five specimens which he had examined from the Quadratenkreide of Oberg and Misburg, the figured holotype coming from the former locality (protograph: 1910, Pl. xxxv, fig. 3; skeletal elements, text plate XIII, fig. 11).

18394. ***Marshallia tortuosa*** (Roemer) (p. 291).

HOMOTYPE

This species was described in 1864 by Roemer from the Quadratenkreide and was found on the Ihme near Hanover (p. 15, Pl. vi, fig. 1). The holotype is in the University Collection at Göttingen. In 1878 Zittel, in the first of his sponge studies (p. 58), described the genus *Marshallia* including under it *Pleurostoma tortuosum* Roemer. This revision Schrammen accepts (1910, p. 291) giving a full description of the species and one which is more complete than the protograph. He also figures the skeletal elements (text plate xv, fig. 12), since no illustration of them had previously appeared in the literature. Schrammen adds as further occurrences, the Quadratenkreide and Mucronatenkreide of Misburg.

18395. *Coscinopora infundibuliformis* Goldfuss (p. 293). PLESIOTYPES

This species was described in 1826 by Goldfuss (pp. 30, 85) from the Cretaceous Marl of Coesfeld. (Cotypes figured: p. 30, Pl. ix, figs. 16a, b, c; Pl. xxx, fig. 10.) Schlüter (1872, p. 22) records that this species is abundant in the Mucronaten beds of Coesfeld, Münsterland. Quenstedt (1877, p. 461) notes its presence in abundance at Ahlten, while Hinde ('Catalogue,' p. 105) has listed it from the Upper Chalk of Croyden, Surrey and in the south of England. Gripenkerl speaks of its abundance in the upper Quadraten beds of Boimstorf and its lesser abundance in the same beds at Glentorf. Wollemann has found it well represented at Gr. and Kl. Biewende (1890, p. 7; 1901, p. 7; 1902b, p. 58). Schrammen in 1910 described the species from the Quadratenkreide and Mucronatenkreide and from Oberg and Misburg (pp. 293, 294) and he figured the skeletal elements (text plate xv, figs. 13 14). Since Schrammen's is the first detailed description appearing in the literature, containing, as it does, dimensions, minute morphological characterizations and having, in addition, the first illustration of the skeletal elements, the ten specimens upon which Schrammen based his description must be regarded as plesiotypes. Six of these are in the Museum Collection.

18396. *Beckisia soekelandi* Schlüter (p. 297).

Schlüter described this species in 1868 (p. 93), naming it in honor of Becks and Soekeland. He referred to the species again in 1870 (pp. 140-141) but did not give any illustrations of it until 1872, when he figured two specimens and a diagram of the structure of the meshwork (1872, Pl. i, figs. 5, 6, 7), at which time he also gave a more complete description than he had yet published. Because of the restricted distribution of this species, Schlüter makes it one of the zonal fossils of the Quadratenkreide, using it instead of *Belemnitella quadrata* (*Actinocamax quadratus*), while he uses *Lepidospongia rugosa* instead of *Belemnitella mucronata* for the Upper Senonian (1870, p. 141). He records it from the Upper Quadratenkreide between Lette, Coesfeld, Holtwick and Legden, in none of which places is it to be considered a rare form, but in older or younger beds he states it is unknown. It is also found, according to Schlüter, in the subhercynian Kreide in the same horizon at Biewende a mile and a quarter northeast of Börsum. The beds at Biewende show a surprising similarity to those at Holtwick. Zittel, in his 'Studien' (1878b, p. 58), mentions the species without comment. Quenstedt (1877, p. 489) mentions the occurrence of the species at Coesfeld and reproduces on Pl. cxxxviii, fig. 14 with a reduction of one.

half, the figures given by Schlüter in 1872 (*loc. cit.*). Hinde, in his 'Catalogue' (1883, p. 144), simply mentions the occurrence at Coesfeld, Westphalia.

Griepenkerl calls attention to the restricted occurrence of this species in Königslutter, Braunschweig, parallelling its restriction in Westphalia. It is found only in Goe's marl pit near Boimstorf (1889, p. 23).

Wollemann (1900, pp. 8, 9) reports that the species occurs only seldom and in fragments at Gr. Biewende, the only complete specimen which he knows of being in the collection of the Kaiserliche geologische Landesanstalt in Berlin.

Schrammen (1910, p. 297) states that the species does not occur in the Chalk Marl facies of the Quadratenkreide of Hanover, at least, he has never found it at Misburg and Oberg, but instead its place is taken by the nearly related *B. feuerwehri*. It is possible that it occurs also in the shaly Granulatenkreide around Braunschweig, but Schrammen is not positive on account of the poor preservation of the material therefrom

18397. *Becksia augustæ* Schrammen (p. 298).

HEAUTOTYPES

Schrammen described this species in 1902 (p. 18) from the Quadratenkreide of Misburg whence came the holotype (figured Pl. II, fig. 2) now in the Roemer Museum. In 1910 Schrammen gave a fuller description of the species (p. 298), reproduced the protograph (Pl. XL, fig. 1; skeletal elements, text plate XIV, fig. 5), and noted the further occurrence from the Quadratenkreide of Oberg. The specimens in the American Museum Collection do not come from the locality of the type specimen, but have been identified by Schrammen and used in amplifying the protolog; they are, therefore, heautotypes.

18398. *Becksia feuerwehri* Schrammen (p. 298).

PARATYPES

Schrammen described this species from four specimens from the Quadratenkreide of Oberg (1910, p. 298) figuring the holotype on Pl. XL, fig. 4. There are four specimens in the collection, none of which is figured, though two of them are far superior to the protograph. One specimen shows this species growing upon *Phymatella intumescens* (Roemer) (18398a).

18399. *Plocoscyphia centuncula* Schrammen (p. 301).

PARATYPE:

Schrammen described this species in 1910 from the Quadratenkreide and Mucronatenkreide, and from Misburg, Oberg, Ahlten, and

Glentorf. The figured holotype came from the Quadratenkreide of Oberg (Pl. XL, fig. 5; skeletal elements, text plate XIV, fig. 2). In his synonymy Schrammen includes, doubtfully, *Plocoscyphia annulata* as used by Griepenkerl 1889 (p. 23). Since Griepenkerl merely identified a fragment from Königslutter with Roemer's *Mæandrosporgia annulata* giving no figure and only the briefest description, referring to Roemer's illustration (1864, p. 53, Pl. XVIII, fig. 9), it is difficult to understand why Schrammen did not include in his synonymy of *P. centuncula*, Roemer's *M. annulata* as well as Griepenkerl's *P. annulata*. Roemer's protograph is characteristically poor and the protolog is very brief. Schrammen nowhere refers to either except in his revision of Roemer's illustrations where he states that *M. annulata* is a Hexactinellid, leaving further taxonomic revision for future study (1910, p. 6).

18400. **Centrosia incrustans** Schrammen (p. 302). PARATYPES OR
HEAUTOTYPES

In 1902 (p. 16) Schrammen described the new genus *Kentrosia* with the genoholotype and only species *K. incrustans* from the Quadratenkreide of Oberg and Misburg (p. 17). The figured holotype is from the Quadratenkreide of Oberg (Pl. IV, fig. 6) and is now in the Roemer Museum. In 1910 Schrammen (p. 302) gave Oberg as the only locality from which the species is known, and figured another specimen from the Quadratenkreide of Oberg (Pl. XXXIX, fig. 1; skeletal elements, text plate XIV, fig. 1). The two specimens in the collection are either paratypes, if belonging to the original series, or heautotypes, if belonging to the material used for the 1910 description.

18401. **Callicylix farreides** Schrammen (p. 302). COTYPES

In 1910 Schrammen erected the new genus *Callicylix* with the genoholotype and sole species *C. farreides* from the Quadratenkreide of Oberg (p. 302). There are two figured cotypes (*loc. cit.*, Pl. XL, figs. 7, 8). In American Museum Collection there are four of the eight specimens examined by Schrammen in describing the species, but none is figured.

18402. **Cyclostigma acinosa** Schrammen (p. 303). PARATYPES OR
HEAUTOTYPES

In 1902 Schrammen (p. 17) described the new species *Plocoscyphia acinosa* from the Quadratenkreide of Oberg and figured the holotype (Pl. IV, fig. 2) now in the Roemer Museum. When he brought out his

Monograph he made a new genus *Cyclostigma*, with the genoholotype *Plocoscyphia acinosa*, without stating his reasons for making the generic revision (1910, p. 303). At this time he was able to record the species from the Mucronatenkreide as well, and also from Misburg. There are three good specimens in the Museum Collection and they are either paratypes or heautotypes.

18403. ***Cyclostigma mæandrina*** Schrammen (p. 304). PARATYPE

Schrammen described this species from two specimens examined by him from the Quadratenkreide of Oberg. The figured holotype (Pl. XL, fig. 6; skeletal elements, text plate xiv, fig. 4) is different from the specimen in the Museum Collection, which is thus a paratype.

18404. ***Cystispongia monostoma*** Schrammen (p. 316). PARATYPE

Schrammen in describing this species (1910, p. 316) gives no figure of an entire specimen, illustrating only the skeletal elements (1910, text plate xv, fig. 9). These are from the Quadratenkreide of Oberg and must be considered as constituting the holotype. Schrammen states that he had examined four specimens from the Quadratenkreide of Misburg and Oberg, one of which it is to be supposed is in the American Museum Collection.

18405. ***Tremabolites megastoma*** (Roemer) (p. 317). PLESIOTYPES

From the Untere Kreide of Peine, Roemer described a form which he called *Manon megastoma* (1841, p. 3), figuring the holotype (Pl. I, fig. 9). Schlüter twice cited the species from the zones of *Becksia soekelandi* and *Lepidospongia rugosa* in Münsterland referring it, however, to the genus *Camerospongia* (Schlüter, 1872, p. 19; 1876-1877, p. 244). Zittel, in 1877, erected the genus *Tremabolites* with Roemer's *Manon megastoma* as the genoholotype.

Since Roemer's protograph and protolog were very poor, and since the latter was not couched in modern terminology, we must look upon Schrammen's description in 1910, made from the type material and from specimens collected from the type locality, as the first really complete description, and the specimens in Schrammen's collection used in making the description must be considered plesiotypes. Schrammen figured two specimens from the Quadratenkreide of Oberg (1910, Pl. XXXI, figs. 4, 5) and a single individual from the Mucronatenkreide of Misburg (Pl. XXXIX, fig. 3). The skeletal elements figured are from the form of the locality (*loc. cit.*, text plate, xv, figs. 7, 8).

18406. **Toulminia wollemanni** Schrammen (p. 319).

PARATYPE

Schrammen described this species from the Quadratenkreide of Oberg in 1910 (p. 319), figuring the holotype (Pl. xxxix, fig. 6; skeletal elements, text plate xv, fig. 6). He states that he had examined only two specimens, so that presumably the one in the Museum Collection is the second besides the figured one.

18407. **Phalacrus flosculus** Schrammen (p. 321).

COTYPES

This species is the first described by Schrammen under his new genus *Phalacrus*, but he does not designate it as the genoholotype for which reason it simply becomes one of the genosyntypes (1910, p. 321). It is a rare genus known only from the Quadratenkreide of Oberg whence two cotypes are figured (Pl. xxxix, figs. 7, 8; skeletal elements, text plate xv, figs. 3, 4).

18408. **Phalacrus decurrens** Schrammen (p. 323).

METATYPE

Schrammen described this species from a single specimen ["Das Original ist Unikum"] which he did not figure. Since the dimensions of the specimen in the collection do not agree with those which he gives in the protolog, the specimen must either have been overlooked by him at the time of writing or else have been collected at some later date; in either case it is a metatype.

18409. **Cœloptychium decimum** Roemer (p. 329).

PLESIOTYPE

Roemer described this species in 1841 from the Untere Kreide of Peine, Hanover (p. 10) and figured the holotype (Pl. iv, fig. 3). In 1864 he gave a brief notice of it again, but did not figure it or add to the description or occurrences (1864, p. 3). Zittel has given by far the best description of this species that has yet appeared in print and his illustrations are in all respects superior to the protograph. In writing his description he had before him Roemer's types of this and related species, so that his characterization is particularly valuable (1876, pp. 62-65, Pl. i, figs. 6, 7; skeletal elements, Pl. iii, fig. 2). He notes its occurrence in the Quadratenkreide at Vordorf near Braunschweig and at Schwiechelt near Peine, and in the Mucronatenkreide at Ahlten in Hanover.

Wollemann reports this species from the *Heteroceras* zone of the Mucronatenkreide of Zeltberg, near Lüneberg (1902a, p. 11) and Schrammen lists it from Oberg, Biewende, and from Misburg (rare), but gives no figures (1910, p. 329).

18410. *Cœloptychium agaricoides* Goldfuss (p. 330).

PLESIOTYPE

This species was described by Goldfuss from the marl of Coesfeld (1826-33, p. 31; protograph, Pl. ix, fig. 20 *a-e*). Roemer (1841, p. 10) gave an unusually good description of the same species, figuring an entire individual with the stem (Pl. iv, fig. 5), and noted its occurrence in the Lower Cretaceous of Peine and Theidessen and in the Upper Cretaceous marl of Lemförde and Coesfeld, to which localities he added Vordorf in 1864 (p. 3). The species has been reported by more recent writers from various parts of northwest Germany, namely, from the zones of *Becksia soekelandi* and *Lepidospongia rugosa* in the Quadraten and also from the Mucronaten of Münsterland (Schlüter, 1872, p. 16; 1876-1877, p. 244); from the Upper Quadraten of Boimstorf, Braunschweig, where it is absent in the Mucronaten zones (Griepenkerl, 1888-1889, p. 24); from the Senonian of Gr. and Kl. Biewende in Braunschweig (Wollemann, 1901, p. 9; 1902*b*, p. 58); and from the *Heteroceras* zone of the Mucronatenkreide of Zeltberg, near Lüneberg, Hanover (Wollemann, 1902*a*, p. 11).

By far the most exhaustive discussion of the species is that given by Zittel in his paper *Ueber Cœloptychium*. He has carefully revised and amplified the protolog (1876*a*, pp. 59-61) and has figured numerous details of structure and of the skeletal network (Pl. III, figs. 1, 4, 5, 6, 10, 11, 13 and Pl. iv, fig. A).

From the Upper Senonian horizons Schrammen has collected many specimens at Misburg, Oberg, Linden, and Ahlten in the Kalkmergel of the Quadraten- and Mucronatenkreide and in the Sandmergel of the Mucronatenkreide (1912, p. 331). In the collection is a single specimen which is a plesiotype, since it was among those used by Schrammen in making his additional notes on the species.

18411. *Cœloptychium rude* von Seebach (p. 333).

There are in the Göttingen University Museum four specimens of sponges labelled by von Seebach *Cœloptychium rude*, but described only in manuscript by von Seebach. Zittel has described the species in his paper on *Cœloptychium* (1876, p. 71) and has figured one of Seebach's specimens (*loc. cit.*, Pl. I, figs. 1, 2), given to him for that purpose by Seebach, showing the top and side view slightly reduced. The specimens come from the Mucronatenkreide of Ahlten. Wollemann records the species from the *Heteroceras* zone of the Mucronatenkreide of Zeltberg, near Lüneburg, Hanover.

Schrammen, in 1910, noted the occurrence of this form from the Mucronatenkreide of Misburg and figured the skeletal elements (Pl. XLV, fig. 3, text plate xv, fig. 10). The specimen in the American Museum is not a type, but is included for the sake of having as complete a representation of species as possible.

SPECIES FROM THE QUADRATENKREIDE OF MISBURG, HANOVER

18412. **Theneopsis steinmanni** (von Zittel) (p. 55). PLESIOTYPE
See No. 18281.

18413. **Doryderma (Homalodora) ramosa** (Mantell) (p. 59). PLESIOTYPE
See No. 18284.

18414. **Doryderma capitata** Schrammen. CHIROTYPY

Schrammen, in his Monograph, records no species of *capitata* under *Doryderma*. The specimens of other species which he figures are all from Oberg and none agrees with the one which he has labelled *D. capitata*. This specimen therefore appears to constitute a chirotype, unless further study proves it to be the same as one of his new species described in the Monograph; if such were the case, it would mean that Schrammen had forgotten that he had already given a name to this form.

18415. **Amphilectella piriformis** Schrammen (p. 61). PARATYPE OR
HEAUTOTYPE

See No. 18288 for a discussion of this species. The specimen in the collection is from the type locality, but whether belonging to the original series and so a paratype, or to material subsequently collected and so a heautotype, there is no way of knowing.

18416. **Pachypoterion koeneni** Schrammen (p. 63). PARATYPE
See No. 18259.

18417. **Pachinion scriptum** (Roemer) (p. 67). PLESIOTYPE
See No. 18204.

18418. **Pachinion cylindricum** Schrammen (p. 68). PARATYPE OR
HEAUTOTYPE

See No. 18293. Since the holotype of this species came from the Quadratenkreide of Misburg, the specimen in the collection is either one of the paratypes or only a heautotype.

18419. **Phymatella bulbosa** von Zittel (p. 75).
See No. 18207.
18420. **Phymatella tuberosa** (Quenstedt) (p. 76).
See No. 18208.
18421. **Phymatella spæroides** Schrammen (p. 76).
See No. 18241.
18422. **Aulaxinia sulcifera (typica)** (Roemer) (p. 78).
See No. 18301.
18423. **Craterella tuberosa** Schrammen (p. 80). PARATYPES OF
See No. 18302. Since Misburg is the type locality for
the two specimens in the collection are either paratypes or
18424. **Callopegma acaulis** von Zittel (p. 81).
See No. 18304.
18425. **Turonia constricta** von Zittel (p. 87).
See No. 18307.
18426. **Siphonia tubulosa** (Roemer) (p. 93).
See No. 18311.
18427. **?Placoscytus jeresæformis** Schrammen (p. 102).
See No. 18496.
18428. **Phymaraphinia infundibuliformis** Schrammen (p. 103).
COTYPE OF
See No. 18320.
18429. **Cycloclema compressa** (Hinde) (p. 105).
See No. 18321.
18430. **Ophiraphidites cylindricus** Schrammen (p. 121).
See No. 18330.
18431. **Ophiraphidites infundibuliformis** Schrammen (p. 122).
See No. 18331.
18432. **Ophiraphidites tuberosus** Schrammen (p. 124).
See No. 18332.

- 18433.
- Pachycothion giganteum**
- (Roemer) (p. 130).

PLESIOTYPE

The representative of this species was labelled by Schrammen "*Pachycothion simplicissimus* Počta sp." and must have been so identified prior to the writing of the Monograph, for he there makes Počta's species a synonym of *P. giganteum* (Roemer) (1910, p. 130; see also for details No. 18183).

- 18434.
- Verruculina macrommata**
- (Roemer) (p. 140).

PLESIOTYPE

This species was described by Roemer (1864, p. 45, Pl. XVI, fig. 4) from the Mucronatenkreide of Ahlten, as *Verrucospongia macrommata*. Zittel ('Studien,' 1878c. II, p. 124), erecting the generic name *Amphithe-lion* for parts of several existing generic names, placed Roemer's species therein. Hinde, on the other hand (1883, p. 40), still retained the original generic assignation given by Roemer. Schrammen in his second Roemer Museum paper (1901, p. 21) accepts Zittel's revision, but by the time of the publication of the Monograph has decided to place *macrommata* under Zittel's *Verruculina*. He includes also as synonyms under this species *V. reussii* (M'Coy) as given by Hinde, and *V. papillata* Hinde. M'Coy's specific name (originally *Manon reussii*) would have priority, having been given in 1848, were it not for the fact that the species was inadequately described and not figured by M'Coy and because Hinde, claiming that M'Coy's species could be recognized, identified it as the same as *V. circumporosa* Quenstedt [= *V. crassa* (Roemer)] which latter is not, however, according to Schrammen, the same as the one described by Hinde as *V. reussii*. Hinde states that *V. reussii* and *V. papillata*, occurring in the Upper Chalk at Flamborough, are distinguished from *V. macrommata* by the papillose postica, but Schrammen states that these are not rare on *macrommata*. (The label on the specimen in the Museum has mutation ant. on it at the bottom. This designation probably refers to the fact that Schrammen's specimens are found in an earlier horizon than was Roemer's holotype.)

Schrammen listed the species from the Kalkmergel of the Quad-ratenkreide and Mucronatenkreide from Misburg, Oberg, Adenstedt and Ahlten, figuring some spicules from the last locality (1910, text plate VIII, fig. 6).

- 18435.
- Verruculina seriatopora**
- (Roemer) (p. 141).

PLESIOTYPE

See No. 18342.

- 18436.
- Verruculina cupula**
- Schrammen (p. 142).

COTYPE

See No. 18343.

18437. **Stichophyma multiformis** (Bronn) (p. 145).

PLESIOTYPE

Bronn, in 1838, described this species as *Siphonia multiformis* ('*Lethæa Geognostica*,' Bd. II, p. 591, Pl. xxvii, fig. 20), noting its occurrence in the Glauconitic Marl Chalk of Vouziers in the Ardennes. The species is appropriately named *multiformis*, for it varies so greatly in size and form that these characteristics can hardly be used for identification. Schrammen states that the largest individual which he knows of is 55 cm. long, the smallest 3.5 cm. The largest in the American Museum Collection is over 20 cm. in length. Roemer (1864) revised the species, placing it under *Jerea* (p. 33) and recording its occurrence in the Quadratenkreide of Peine. Schrammen, accepting Zittel's revisional name *Jereica*, placed the species under that genus in 1901 (p. 21) and also in his second paper (1902, p. 3).

Previous to this, Hinde (1883, p. 41, Pl. v, figs. 3, 4) had described a new species *Stichophyma tumida* from the Upper Chalk of Flamborough, Yorkshire and Bromley, Kent. This species Schrammen, in his Monograph, considers the same as Bronn's *Siphonia multiformis* which he no longer leaves under the genus *Jereica* but changes to *Stichophyma*. Schrammen, remarking on the fact that the young stages of *Stichophyma multiformis* from the Senonian recall in the arrangement and size of ostia and postica those in the adult *S. verrucosa* from the Turonian, considers that it is quite likely that the former is simply a further development from the latter. Unfortunately, the beds of intermediate age in northwest Germany, where one would look for the transitional forms, are not developed in a facies suitable to sponges.

Schrammen lists the species from the Kalkmergel of the Quadratenkreide and Mucronatenkreide from Misburg, Oberg, Adenstedt and Biewende. He has given the best description that has yet appeared in the literature, but, unfortunately, has not figured any of the specimens from his collection, and since no other author has published illustrations of this species except the describer, we have only the protograph to refer to. This shows the external form and gives some idea of the surface characteristics, but the skeletal elements have never been figured.

18438. **Jereica polystoma** (Roemer) (p. 147).

PLESIOTYPE

Roemer described this species (1864, p. 34, Pl. xii, fig. 5) from the Mucronatenkreide of Ahlten as *Jerea polystoma*. Zittel, in his 'Studies' (II, p. 126), erected the new genus *Jereica* ("like *Jerea*") for parts of *Jerea* and a number of other genera, stating that it was so like *Jerea* that it could only be distinguished therefrom by the microscopic structure.

Schrammen does not accept Griepenkerl's identification of a specimen from Sudmerberg as *Jereica punctata* (Münster), but considers that it likewise belongs under *J. polystoma*. Griepenkerl does not figure the single specimen which he had observed in Renzelmann's collection ('Königslutter,' 1888-1889, p. 17) and his description is so brief that it hardly seems possible that Schrammen had enough evidence to declare that Griepenkerl's identification was not valid, unless we assume that he had seen the specimen in question. Since Schrammen recognizes and accepts as of good standing the species *Jereica punctata* (Münster) Goldfuss which is known only from the sand marl of Sudmerberg, and since he does not list *J. polystoma* (in which he includes *J. punctata* as listed by Griepenkerl) from Sudmerberg or from an horizon lower than the Quadratenkreide, his synonymies are open to question, in so far as Griepenkerl's identification is concerned.

18439. *Jereica oligostoma* Schrammen (p. 148). COTYPE

This species is based upon eight specimens coming from the higher Senonian horizons and from Misburg, Oberg, and Adenstedt; it is not figured by Schrammen and no holotype is designated (Monograph, p. 148).

18440. *Scytalia terebrata* (Phillips) Hinde (p. 150). PLESIOTYPES
See No. 18189.

18441. *Scytalia radiciformis* (Phillips) (p. 151). PLESIOTYPE
See No. 18344.

18442. *Leiochonia cryptopora* Schrammen (p. 160). PARATYPE OR
HEAUTOTYPE
See No. 18345.

18443. *Seliscothion planum* (Phillips) Hinde (p. 163). PLESIOTYPE
See No. 18224.

18444. *Hexactinella laevis* Schrammen (p. 224). IDIOTYPE

The holotype of this species was described and figured by Schrammen from the Quadratenkreide of Oberg (see No. 18360) and no mention was made of its occurrence at Misburg. The specimen in the collection therefore is an idiomorph.

18445. **Leptophragma pusillum** Schrammen (p. 236). PARATYPE

The holotype was described and figured by Schrammen from the Quadratenkreide of Oberg (1902, p. 22, Pl. III, fig. 5), the species being recorded also from Misburg, though in his Monograph Schrammen lists it only from Oberg (see No. 18366) and seems thus to have overlooked the specimen now in The American Museum of Natural History which comes from Misburg, and is, therefore, a paratype. The species is of interest as being the smallest Hexactinellid from the Senonian of Hanover.

18446. **Guettardia stümpell** Schrammen (p. 240). PARATYPE OR
HEAUTOTYPE

This species was described by Schrammen in 1902 (p. 22), from the Quadratenkreide of Misburg and Oberg, the holotype being from the latter locality (protograph, Pl. IV, fig. 3). In 1910 Schrammen greatly amplified the protolog and figured another specimen from the Quadratenkreide of Oberg (Pl. XXX, fig. 9) and likewise the skeletal elements (text plate IX, fig. 3). He notes that the species may occur also in the lower Senonian of Adenstedt-Bühlten from which he has specimens which are, however, not to be identified with absolute certainty because the canal system is poorly preserved. In his Monograph he cites the species only from the Quadratenkreide of Oberg. This is clearly an oversight on his part, as the specimen in the collection labelled by him fully testifies.

18447. **Guettardia striata** Schrammen (p. 241). COTYPE

Schrammen described this species (1910, p. 241) from six specimens collected by him from Gleidingen, Misburg, and Oberg, the two figured cotypes coming from the Quadratenkreide of Oberg (*loc. cit.*, Pl. XXX, figs. 6, 7, 8; skeletal elements, text plate IX, fig. 5). The single specimen in the collection is only a "wing" of sponge.

18448. **Balantionella elegans** Schrammen (p. 261). COTYPES OR
HEAUTOTYPES

See No. 18378.

18449. **Ventriculites radiatus** Mantell (p. 265). PLESIOTYPE

The specimen in the collection was labelled by Schrammen '*Ventriculites cribrosus* Phillips sp.' and was evidently identified by him some time before he wrote his Monograph, because he there recognizes that *V. cribrosus* (Phillips) is a synonym of *V. radiatus* Mantell (1910, p.

265). Thus, although it at first appeared that there was no representative of *V. radiatus* from the Quadratenkreide of Misburg in the collection, it is apparent that the specimen incorrectly labelled by Schrammen is a *radiatus*. It is a very fine specimen showing the typical umbrella form of this species. (For complete notes on the species see No. 18191.)

18450. *Ventriculites stellatus* Schrammen (p. 267). PARATYPES OR
HEAUTOTYPES

Misburg is the type locality for this species, the figured holotype having come from the Quadratenkreide (Schrammen, 1902, p. 11: see further No. 18381).

18451. *Lepidospongia fragilis* Schrammen (p. 269). COTTYPES OR
HEAUTOTYPES

See No. 18383.

18452. *Napsa striata* Schrammen (p. 273). PARATYPE OR
HEAUTOTYPE

See No. 18385.

18453. *Polyblastidium racemosum* (T. Smith) (p. 275). PLESIOTYPE

See No. 18386.

18454. *Sporadiscinia decheni* (Goldfuss) (p. 280). PLESIOTYPE

See No. 18389.

18455. *Sporadiscinia venosa* (Roemer) (p. 281). PLESIOTYPE

See No. 18390.

18456. *Sporadiscinia micrommata* (Roemer) (p. 281). PLESIOTYPE

See No. 18391.

18457. *Sporadiscinia stirps* Schrammen (p. 282). COTYPE

This is a rare species found by Schrammen in the Kalkmergel of the Quadratenkreide of Misburg and Oberg and described from three specimens (1910, p. 282). The one figured specimen comes from the Quadratenkreide of Misburg (*loc. cit.*, Pl. xxxviii, fig. 7); the skeletal elements figured are from the Quadratenkreide of Oberg. The specimen in the collection is almost like the figured one, but the ostia do not show so distinctly.

18458. *Sporadiscinia quenstedti* Schrammen (p. 282). PARATYPE

See No. 18392.

18459. *Becksia augustæ* Schrammen (p. 298). PARATYPE OR HEAUTOTYPE

The specimen in the collection comes from the type locality and horizon and is either a paratype, if from the original material, or a heautotype, if from subsequently collected material.

18460. *Cystispongia monostoma* Schrammen (p. 316). PARATYPE

See No. 18404.

18461. *Tremabolites megastoma* (Roemer) (p. 317). PLESIOTYPE

See No. 18405.

The Mucronatenkreide (Zone 4 of Stolley; Zones 2 and 3 of the Ober-senon of Schlüter)

SPECIES FROM MISBURG

18462. *Stolleya ornatissima* Schrammen (p. 51). HEAUTOTYPE

See No. 18278.

18463. *Stolleya microtulipa* Schrammen (p. 51). HEAUTOTYPE

See No. 18279.

18464. *Theneopsis steinmanni* von Zittel (p. 55). PLESIOTYPE

See No. 18281.

18465. *Doryderma (Brochodora) roemeri* (Hinde) (p. 58). PLESIOTYPE

See No. 18180.

18466. *Doryderma (Brochodora) ramusculus* Schrammen (p. 59). PARATYPE

See No. 18283.

18467. *Doryderma (Homalodora) ramosa* (Mantell) (p. 59). PLESIOTYPE

See No. 18284.

18468. *Doryderma (Homalodora) tuberosa* Schrammen (p. 60). COTYPE

See No. 18286.

18469. *Doryderma (Homalodora) ficus* Schrammen (p. 60). PARATYPE

See No. 18287.

18470. *Amphilectella piriformis* Schrammen (p. 61). PARATYPES & HEAUTOTYPES

18471. ***Heterostinia immanis*** Schrammen (p. 63).

PARATYPE

The holotype and figured specimen of this species comes from the Mucronatenkreide of Misburg where the form is confined, according to Schrammen (1910, p. 63, Pl. xvii, fig. 1). He states that he has examined only two specimens so that the one in the American Museum Collection is a paratype. (For further occurrence of this species at Oberg see No. 18290.)

It is evident that the specimen which Schrammen describes on page 63 as having a height of about 20 cm. without the stem is the one in the collection. In his description of the species he speaks of the similarity between this and *Pachypoterion auritum* and of the possibility of distinguishing the two by the surface features. In *Heterostinia immanis* "the supporting skeleton on the outside is thick and smooth and is only broken through by numerous round ostia which are several millimeters apart" (Schrammen, 1910, p. 64). In *Pachypoterion auritum*, on the other hand, the water enters through the holes (0.5 -1 mm. in width) of the skeleton mesh which covers the surface in a net-like manner. A comparison of figures 1 and 4 on Pl. xvi, shows clearly the differences between *Heterostinia immanis* and *Pachypoterion auritum*.

18472. ***Heterostinia depressa*** Schrammen (p. 61).

METATYPE

A single specimen from the Mucronatenkreide of Misburg was used by Schrammen in describing this species (1910, p. 63, Pl. xv, fig. 5). The surface and canal system are the same as in *H. immanis* from which *H. depressa* differs mainly in the external form. In the Museum Collection is a bottle containing two fragments of the sponge wall and some skeletal elements. If these fragments and spicules are from the original specimen they are parts of the holotype, but if subsequently collected by Schrammen they constitute metatypes.

18473. ***Pachypoterion auritum*** Schrammen (p. 64).

METATYPE

This species was described by Schrammen in 1910 from a single specimen from the Kalkmergel of the Mucronatenkreide of Misburg (p. 64; protograph, Pl. xvi, fig. 4; skeletal elements, text plate II, fig. 5). In the collection is a very poor specimen in which all of the surface features are obscured. Since Schrammen did not use it in his protograph, but since he did identify the specimen, it is a metatype.

18474. ***Pachinion scriptum*** (Roemer) (p. 67).

PLESIOTYPES

See No. 18204.

18475. **Procorallistes polymorphus** Schrammen (p. 69). COTYPES OR
HEAUTOTYPES

This species is one of the two genosyntypes of Schrammen's genus *Procorallistes* erected in 1901 (p. 15). *P. polymorphus* was described from the Quadratenkreide of Oberg and Misburg and the Mucronatenkreide of Misburg. Schrammen figured an entire specimen from the Quadratenkreide of Oberg (*loc. cit.*, Pl. I, fig. 10) and several spicules from the Mucronatenkreide of Misburg (Pl. v, fig. 8). The three specimens in the collection are thus cotypes, if belonging to the original series, or heautotypes, if a part of that used for supplementing the protograph and protolog.

The second genosyntype described by Schrammen was *P. tuberosus* from the Quadratenkreide of Oberg (1901, p. 15, holotype figured, Pl. I, fig. 11). The original of this and of the first species are in the Roemer Museum. In his Monograph, Schrammen made this species a synonym of *P. polymorphus* (1910, p. 69) and figured two new specimens (heautotypes), one from the Cuvieri Pläner of Heere (*loc. cit.*, Pl. xx, fig. 1), the other from the Mucronatenkreide of Misburg (*idem*, fig. 2).

18476. **Phalangium cylindratum** Schrammen (p. 70). IDIOTYPE

See No. 18205.

In the notes on the specimens from Nettlingen, attention was called to the fact that this species was recorded by Schrammen only from the Cuvieri Pläner of Heere despite the fact that he himself had identified and labelled a large specimen from the Scaphites Pläner of Nettlingen. It is somewhat unusual, though not unique, that a species found in the lowest Turonian should occur also in the upper Senonian. There is one well-preserved specimen in the collection from the Mucronatenkreide of Misburg.

18477. **Phalangium scytaliforme** Schrammen (p. 70). PARATYPE (Spicules)

See No. 18238.

18478. **Propachastrella primæva** (von Zittel) (p. 71). PLESIOTYPES

See No. 18295.

18479. **Phymatella bulbosa** von Zittel mut. **postera** Schrammen (p. 75).

CHIROTYPES

See No. 18297.

18480. **Phymatella tuberosa** (Quenstedt) (p. 76). PLESIOTYPE

See No. 18298.

18481. *Aulaxinia sulcifera* (*typica*) (Roemer) (p. 78). PLESIOTYPE
See No. 18301.

18482. *Aulaxinia sulcifera maliformis* Schrammen (p. 78). METATYPE

Schrammen described this species from a single specimen from the Mucronatenkreide of Misburg, but he did not figure it. In the description he stated that the original example was 5 cm. high without the stem. The specimen in the collection, however, is 11 cm. high with the stem or at least 8 cm. without it. It is thus not the holotype, but only a meta-type.

18483. *Aulaxinia fallax* Schrammen (p. 78). IDIOTYPE

The holotype of this species is from the Quadratenkreide of Oberg (Schrammen, 1910, pp. 78, 79, protograph, Pl. I, fig. 4). Schrammen does not mention its occurrence in the Mucronatenkreide nor yet at Misburg, but the specimen in the Museum Collection is labelled by Schrammen himself. It is, therefore, an idio-type.

18484. *Craterella auricula* Schrammen (p. 80). COTYPE

This species was described by Schrammen from Misburg and Oberg from the Quadratenkreide and Mucronatenkreide (1910, p. 80, Pl. XI, figs. 6, 7). He suggests that it is possible that *Craterella auricula* and Zittel's *Callopegma schloenbachi*, which is one of the species which Schrammen has not found and which Zittel has only briefly described without figuring, may be identical. *Craterella auricula* is the only species in the Senonian of northwest Germany which Zittel's description of *Callopegma schloenbachi* would fit and which at the same time resembles the genoholotype of *Callopegma*, namely *C. acaulis* Zittel, in the structure and arrangement of the supporting skeleton (Schrammen, 1910, p. 80). The two figured cotypes are from Misburg, but the specimens in the American Museum Collection does not correspond with either illustration.

18485. *Craterella tuberosa* Schrammen (p. 80). IDIOTYPES

See No. 18302 for a discussion of this species. Schrammen has noted its occurrence only in the Quadratenkreide so that the four specimens in the collection, though from the type locality, are only idiotypes, because from an unrecorded horizon.

18486. *Callopegma acaulis* von Zittel (p. 81). PLESIOTYPE

See No. 18304.

18487. **Turonia variabilis** Michelin (p. 86). PLESIOTYPE
See No. 18306.

18488. **Turonia constricta** von Zittel (p. 87). PLESIOTYPE
See No. 18307.

18489. **Turonia induta** von Zittel (p. 87). PLESIOTYPES

Zittel, in 1878 ('Studien,' II, p. 150, Pl. ix, fig. 2), gave a brief description of this species which occurs in the Quadratenkreide of Linden. *Turonia induta* is the smallest of the species of that genus, being usually about the size of a walnut, or smaller. Though Schrammen has figured three specimens from the Mucronatenkreide of Misburg (1910, Pl. xi, figs. 4, 5, Pl. xv, fig. 3), none corresponds with the specimens in the Museum of which there are five.

18490. **Turonia cerebriformis** Schrammen (p. 88). IDIOTYPES

See No. 18308 for notes on this species. Since Schrammen states that this species is confined to the Quadratenkreide of Oberg, it is interesting to note that there are in the Museum Collection three poorly preserved specimens from the Mucronatenkreide of Misburg labelled by Schrammen, which are thus idiotypes.

18491. **Siphonia tubulosa** (Roemer) (p. 93). PLESIOTYPE
See No. 18311.

18492. **Siphonia maliformis** Schrammen (p. 93). COTYPE

Six specimens were examined by Schrammen in describing this species which occurs at Misburg and Oberg (1910, p. 93). He does not figure any specimens so that all six are cotypes and one of them is in the American Museum Collection. This specimen, while showing the form and the stem, fails to exhibit the characteristic deep paragaster which is one of the chief points of distinction between this and other species of *Siphonia*.

18493. **Discodermia antiqua** Schrammen (p. 97). COTYPES OR HEAUTOTYPES
See No. 18315.

18494. **Discodermia colossea** Schrammen (p. 98). COTYPE

Schrammen described this species from two specimens, the dimensions of which he gives in the text (1910, p. 98). The specimen in the Museum Collection is not quite so large as the measurements which he records for the smaller of the two cotypes. The maximum thickness is

8 cm., not 10 cm., and the length is only 17.5 cm., not 20 cm., unless measured on the curvature. Either the specimen in the Museum is the smaller of the two he describes or else it is another one and would increase the number of examined specimens to three.

18495. **Rhagadinia rimosa** (Roemer) (p. 100).

PLESIOTYPES

See No. 18316.

18496. **Placoscytus jereaeformis** Schrammen (p. 102).

PARATYPES OR
HEAUTOTYPES

In 1901 Schrammen described a new genus *Sollasella* for the single species *jereaeformis* from the Mucronatenkreide of Misburg (p. 6, holotypes figured, Pl. II, fig. 4). He subsequently found that that generic name had already been used for a modern genus by von Lendenfeld and on that account proposed *Placoscytus* in his Monograph (p. 101). By that time, too, he had found the species at Oberg also. The holotype is in the Roemer Museum.

18497. **Phymaraphinia infundibuliformis** Schrammen (p. 105).

COTYPE OR HEAUTOTYPE

See No. 18320.

18498. **Phymaraphinia infundibuliformis** mut. *postera* Schrammen.

CHIROTYPE

Schrammen, in his description of *P. infundibuliformis*, has noted that the specimens from the Quadratenkreide, even when full grown, are smaller than those from the Mucronatenkreide ('Kieselspongien,' 1910-1912, p. 105.) Thus, in the lower horizon, an adult individual has a wall 0.5 cm. in thickness, is about 8 cm. high, and is from 6 to 8 cm. in width at the basal end. But in the Mucronatenkreide have been found specimens measuring 30 cm. in diameter, with walls 3 cm. thick and with ostia a millimeter broad. Schrammen has not given these large individuals at a higher horizon a particular mutation name in print, but it is one of these which he has labelled mut. *postera*. The wall is 1.72 cm. thick, the basal end 3.9 cm. by 4.15 cm. in thickness, and the ostia measure up to a millimeter in diameter. The specimen, though broken, has a diameter of over 19 cm., being thus not so large as the maximum mentioned by Schrammen, but yet far exceeding in dimensions the forms from the Quadratenkreide.

18499. **Astrocladia subramosa** (Roemer) (p. 111).

PLESIOTYPES

See No. 18324.

18500. **Microdendron ramulosum** Schrammen (p. 112). **PARATYPES**

The holotype and figured specimen of this species was described by Schrammen in 1901 (p. 10, Pl. II, fig. 3, Pl. IV, fig. 7) from the Mucronatenkreide of Misburg, and is now in the Roemer Museum. It is one of the smallest of sponges, the largest specimen known to Schrammen being only 2 cm. high (1910, p. 112). It is a species of rare occurrence known only from the type locality whence Schrammen has examined four specimens; two are in the Museum Collection.

18501. **Chenendopora fungiformis** Lamouroux (p. 113). **PLESIOTYPE**

This species was described by Lamouroux from Caen ('Exp. Méthod. des Polypes,' 1821, p. 77, Pl. CXXV, figs. 9, 10). Zittel figured the skeletal elements and noted the occurrence of this form in the Senonian of Evreux near Rouen and of Chatellerault in Touraine ('Studien,' II, 1878, p. 55, Pl. III, figs. 13, 14). Hinde has recorded it from the Upper Greensand of Warminster, Wiltshire, which is interesting in view of the fact that on the Continent it is characteristic of the much higher Senonian beds. Schrammen states that in northwest Germany it is confined to the lower part of the Mucronatenkreide and that even there it is rare.

18502. **Plinthozella squamosa** von Zittel (p. 114). **PLESIOTYPE**

See No. 18325.

18503. **Dactylotus micropelta** Schrammen (p. 115). **COTYLEDON**

See No. 18326.

18504. **Ophiraphidites cf. tuberosus** Schrammen (p. 124).

See No. 18333 for notes on *O. tuberosus*. The specimen in the collection is very poor, being only a mass of spicules, and none of the morphological characteristics of the sponge are retained.

18505. **Pachycothion giganteum** Roemer (p. 130). **PLESIOTYPE**

See No. 18183.

18506. **Verruculina tenuis** (Roemer) (p. 136). **PLESIOTYPE**

See No. 18217.

18507. **Verruculina convoluta** (Quenstedt) (p. 138). **PLESIOTYPE**

See No. 18219.

18508. **Verruculina macrommata** (Roemer) (p. 140). PLESIOTYPES
See No. 18434.

18509. **Verruculina seriatopora** (Roemer) (p. 141). PLESIOTYPES
See No. 18342.

18510. **Verruculina cupula** Schrammen (p. 142). COTYPES
See No. 18343.

18511. **Verruculina astræa** Hinde (p. 142). PLESIOTYPE

From the Upper Chalk of Flamborough, Yorkshire, Hinde described *Verruculina astræa* in 1883 (p. 37, protograph, Pl. III, figs. 5, 5a). The form is distinctive and easily recognized by the anastomosing canals which radiate from the postica. Schrammen added a little to the protograph by giving additional dimensions, especially of the ostia and postica (1910, p. 142). He had examined three specimens from the Mucronatenkreide of Misburg, one of which is in the collection.

18512. **Stichophyma multiformis** (Bronn) (p. 145). PLESIOTYPES
See No. 18437.

18513. **Jereica polystoma** (Roemer) (p. 147). PLESIOTYPES

18514. **Jereica tuberculosa** (Roemer) (p. 147). PLESIOTYPE

This species was described by Roemer in 1864 (p. 35, Pl. XIII, fig. 3) as *Jerea tuberculosa* from the Mucronatenkreide of Ahlten, and not as *Jereica tuberculosa* as Schrammen says in his synonymy (p. 147). It was not placed under *Jereica* until Zittel made his revision in 1880 when he erected that name (see No. 18438). Schrammen includes Wolle-
mann's species *Jereica polystoma* var. *tuberculosa* in this species (Wolle-
mann, 1902, p. 8; Schrammen, 1910, p. 147).

18515. **Jereica oligostoma** Schrammen (p. 148). COTYPES

This species is described from eight specimens examined by Schrammen coming from Misburg, Oberg, and Adenstedt from the Quadraten and Mucronatenkreide. Since no holotype is mentioned or figured all specimens of his original series are cotypes. In the Museum Collection are three from the Mucronatenkreide of Misburg.

18516. **Scytalia terebrata** (Phillips) Hinde (p. 150). PLESIOTYPE
See No. 18189.

18517. *Scytalia cylindrata* Schrammen Ms.

CHIOTYPE

No sponge of this name is described by Schrammen in his Monograph. The specimen is, therefore, a chiotype. It is a slightly flattened, cylindrical form, measuring 19 cm. in height and a little over 5 cm. in its greatest diameter. A small, depressed, circular paragaster about 1 cm. deep is visible at the top. The spicules have not been studied, so that a complete description of the species cannot at this time be given.

18518. *Scytalia radiciformis* (Phillips) (p. 151).

PLESIOTYPES

See No. 18344.

18519. *Pachysalax processifer* Schrammen (p. 157).

METATYPE

This species was described by Schrammen from a single specimen from the Kalkmergel of the Mucronatenkreide of Misburg (1910, p. 157, protograph, Pl. xxii, fig. 2), and constitutes the genoholotype of the monotypic genus *Pachysalax*. Since the specimen in the American Museum Collection is not the figured holotype and was not used by Schrammen in the writing of the protolog, where he distinctly says that he has examined only a single specimen, then it is a metatype, for it was identified by the nomenclator and comes from the type locality and horizon.

18520. *Plinthodermatium exile* Schrammen (p. 158).

PARATYPE

This species is rare in the Mucronatenkreide of Misburg, Schrammen having collected only two specimens, one of which he figures (1910, Pl. xxiii, fig. 1) the other of which is in The American Museum of Natural History.

18521. *Leiochonia robusta* Schrammen (p. 160).

COTYPE

This species was founded by Schrammen for forms which are very similar to *L. cryptoporosa* Schrammen, but which differ chiefly in having a much thicker wall than that species ever acquires. Even in the largest specimens of *L. cryptoporosa* the wall is never more than about 1 cm. thick, while in *L. robusta* it may be as thick as 4 cm. That Schrammen did not originally distinguish these as two separate species is apparent from the fact that he had labelled as *L. robusta* one of the specimens upon the surface of which he has previously printed *L. cryptoporosa*. Yet this is not to be accounted for as a misplaced label; the specimen agrees with his description of *L. robusta* (unfortunately he gives no figure) and the wall is 1.7 cm. thick. He has examined three specimens and one in the American Museum Collection.

18522. *Chonella tenuis* Roemer (p. 161). PLESIOTYPES
See No. 18346.

18523. *Chonella auriformis* Roemer (p. 161). PLESIOTYPE
See No. 18223.

18524. *Coscinostoma fragilis* Schrammen (p. 162). PARATYPE

This is a rare species in the chalk marl of the Mucronatenkreide and has been found by Schrammen only at Misburg, Oberg, and Adenstedt; he has examined only five specimens. It is easy to confuse this species with *Chonella tenuis* which, however, lacks the characteristic grouping of the postica on the inner surface into star-groups. From *Coscinostoma auricula* the species is to be distinguished by its thinner wall and the small and more closely crowded ostia.

The species is the first of the two genosyntypes described by Schrammen under *Coscinostoma*. The photograph is of a specimen from the Quadratenkreide of Oberg (1910, Pl. xxi, fig. 7).

18525. *Coscinostoma auricula* Schrammen (p. 163). PARATYPE

This is one of the rare species in the Mucronatenkreide of Misburg. The specimen which Schrammen speaks of in the text as "the largest in his collection" and which is 7 cm. high, without stem, and 17 cm. across, is the one in the Museum Collection (Schrammen, 1910, p. 163). Since it has been specially pointed out by Schrammen and described, it must be considered a paratype. He points out that this species may be confused with *Chonella auriformis* and that the most readily recognizable distinction lies in the grouping of the postica in *Coscinostoma auricula* and absence of grouping in *Chonella*. The figured holotype is from the Mucronatenkreide of Misburg (*loc. cit.*, Pl. xxi, fig. 8).

18526. *Seliscothion planum* (Phillips) (p. 163). PLESIOTYPE
See No. 18224.

18527. *Seliscothion mantelli* (Goldfuss) (p. 165). PLESIOTYPES
See No. 18350.

18528. *Chalaropegma cerebriformis* Schrammen. HOLOTYPE OR METATYPE
(Spicules)

Schrammen had only a single specimen from which to describe this species which is the genoholotype and sole species in the genus *Chalaropegma* (1910, p. 168). The holotype came from the Kalkmergel of the

Mucronatenkreide of Misburg and was figured (*loc. cit.*, Pl. XIX, fig. 2: skeletal elements, text plate VIII, fig. 8). In the Museum is a bottle containing spicules and a label with the species name, the locality, Misburg, but no horizon. Either the spicules came from the holotype or else were collected subsequently to the publication of the Monograph and are only part of a metatype.

18529. ***Pachytrachelus exspectatus*** Schrammen (p. 174). PARATYPE

This species is rare in the Mucronatenkreide of Misburg, Schrammen having examined only six specimens. The material which he sent to The American Museum of Natural History consists of a bottle of skeletal elements and small fragments, and one specimen which is larger than the figure which he gives and shows the surface features quite as well except that the portion rimming the paragaster has been broken off.

18530. ***Aphrocallistes cylindrodactylus*** Schrammen (p. 220). PARATYPE
See No. 18358.

18531. ***Hexactinella angustata*** Schrammen (p. 223). HEAUTOTYPE

See No. 18359. The type locality for this species is Oberg. At the time of the writing of the protolog, Schrammen described *Polyopesia radiceformis* from the Mucronatenkreide of Misburg, a species which he later included in his synonymy of *Hexactinella angustata*. Thus all of the specimens from Misburg are heautotypes.

18532. ***Leptophragma munchisoni*** (Goldfuss) (p. 235). PLESIOTYPE

This species was described in 1826 by Goldfuss as *Scyphia munchisoni* (p. 219, Pl. LXV, fig. 8). D'Orbigny, in listing the sponges in his 'Prodrome,' placed the species under the genus *Coscinopora* (1850, tome II, p. 284), where by an error he refers to the species as *Scythia munchisoni* Goldfuss instead of as *Scyphia*. Schlüter records that it is abundant in the Upper Quadratenkreide of Münsterland, but that if it occurs at all in the Mucronatenkreide it is very rare and that he had obtained only one doubtful specimen (1872, p. 14). As *Cribrosporgia munchisoni*, A. Roemer records the presence of this species in the Mucronatenkreide at Coesfeld and Lemförde and in the Quadratenkreide of Ilsenburg and Peine. In 1878 Zittel ('Studien,' I, p. 48) created the generic name *Leptophragma* for parts of *Scyphia* of authors, including herein *Scyphia munchisoni* Goldfuss the original specimens of which he had seen. Hinde reports specimens in the British Museum from the Upper Green Sand (?) near Folkstone and the Lower Chalk of the South of

England ('Catalogue,' 1883, p. 102). Griepenkerl states that this species is very abundant in the Quadratenkreide of Boimstorf ('Königslutter,' p. 22). It has been found sparingly at Grosse and Kleine Biewende near Wolfenbüttel (Wollemann, 1901, p. 7). Schrammen lists Misburg, Oberg, Ahlten, Biewende, Münsterland and Glentorf at which the species occurs either in the Quadraten or Mucronatenkreide (1910, p. 235) and he figures a specimen from Quadratenkreide of Oberg (apparently Pl. xxxii, fig. 3 not fig. 1; skeletal elements, text plate ix, fig. 6).

18533. **Leptophragma micropora** Schrammen (p. 237). COTYPE
See No. 18367.

18534. **Pleurostoma dichtoma** Schrammen (p. 239). PARATYPES AND
METATYPES

See No. 18369. Schrammen states, in his Monograph, that he had examined only three specimens, yet there are four in the American Museum Collection, no one of which corresponds to the protograph.

18535. Aff. **Pleurostoma radiata** (Roemer).
See No. 18368.

18536. **Lepidospongia rugosa** Schlüter (p. 269). PLESIOTYPE
See No. 18382.

18537. **Rhisopoterion tubiforme** Schrammen (p. 272). COTYPES

This species is of rare occurrence, being known only from Misburg. In the text Schrammen states that it is known only from the Mucronatenkreide (1910, p. 273), but he figures a specimen from the Quadratenkreide as well. He said that he had only two specimens, but he figures at least three (Pl. xxxiv, figs. 1-5), and there are the two in the Museum Collection which do not fit in with any of the figures.

18538. **Napsa striata** Schrammen (p. 273). IDIOTYPE
See No. 18385. The holotype of this species came from the Quadratenkreide of Misburg; therefore the specimen in the Collection is an idiotype.

18539. **Polyblastidium racemosum** (T. Smith) (p. 275). PLESIOTYPE
See No. 18386.

18540. **Sporadiscinia micrommata** (Roemer) (p. 281). PLESIOTYPE
See No. 18391.

18541. **Sporadiscinia teutonix** Schrammen (p. 283). FIGURED COTYPE AND COTYPES

This species is very similar to *S. venosa* and, indeed, in labelling his material Schrammen originally referred certain of the specimens to *venosa*. In his Monograph he has figured one of these (formerly named *S. venosa*) among his cotypes of *teutonix*. He states that there are only three specimens, but he must have overlooked some since there are five in the Museum Collection including one figured one (see Pl. xxxviii, fig. 2 in the Monograph). The species is known only from the Mucronatenkreide of Misburg.

18542. **Pleurope lacunosa** (Roemer) (p. 290). PLESIOTYPE

Roemer described this species as *Pleurostoma lacunosa* from the Lower Cretaceous of Peine and Lindner Berg near Hanover (1841, p. 5: protograph, Pl. i, fig. 12). Zittel made Roemer's species the genoholotype of a new genus *Pleurope* (1877, p. 58), without describing or figuring the species, which was the only one which he placed in the genus. Since he had not seen Roemer's type his description of the skeletal elements must have been based upon material collected by himself and identified with Roemer's species. Zittel records no horizons or localities.

Schrammen amplified the original description of the species according to Zittel's generic description, noting the occurrence of the species in the Kalkmergel of the Quadraten and Mucronatenkreide at Misburg and Oberg. From the Quadraten of Oberg Schrammen figures one specimen (1910, Pl. xxxiii, fig. 4) and the dermal covering of the inside of a specimen showing the lychnisks (text plate xiv, fig. 16).

18543. **Coscinopora infundibuliformis** Goldfuss (p. 293). PLESIOTYPE

See No. 18395.

18544. **Cystispongia monostoma** Schrammen (p. 316). IDIOTYPE

See No. 18404.

Schrammen has recorded this species only from the Quadratenkreide so that the specimen in the collection from the Mucronatenkreide of Misburg is an idiomorph.

18545. **Tremabolites megastoma** (Roemer) (p. 317). PLESIOTYPE

See No. 18405.

18546. **Cœloptychium decimium** Roemer (p. 329). PLESIOTYPE

See No. 18409.

18547. *Cœloptychium agaricoides* Goldfuss (p. 330). PLESIOTYPES
See No. 18410.

18548. *Cœloptychium seebachi* von Zittel (p. 331). PLESIOTYPE

This species was described by Zittel in his paper on *Cœloptychium* (1876, p. 68, Pl. II, figs. 5, 6, 7, Pl. III, figs. 8, 9, Pl. V, fig. 4) for four specimens from the Mucronatenkreide of Haldem and Lemförde in Westphalia and Lüneburg in Hanover.

SPECIES FROM HALDEM, HANOVER

18549. *Cœloptychium seebachi* von Zittel (p. 331). PLESIOTYPES

The holotype of this species was described and figured by Zittel in 1876 ('*Cœloptychium*,' p. 68, Pl. II, figs. 5, 6, 7; skeletal elements, Pl. III, figs. 8, 9, Pl. V, fig. A). It came from the Mucronatenkreide of Haldem in Hanover, for which reason the two specimens in the Museum Collection, which come from the same locality and horizon, are plesiotypes of unusual value.

SPECIES FROM SASSNITZ ON RÜGEN

18550. *Aulaxinia* aff. *sulcifera* (typica) (Roemer) (p. 78).

See No. 18301 for a description of this species.

18551. *Phymatella sphæroides* Schrammen (p. 76). IDIOTYPE

See No. 18241.

SPECIES FROM AHLTEN, HANOVER

18552. *Rhagadinia rimosa* (Roemer) (p. 100). PLESIOTYPES

See No. 18316.

18553. *Sporadiscinia micrommata* (Roemer) (p. 281). HOMœOTYPE

See No. 18391.

18554. *Sporadiscinia quenstedti* Schrammen (p. 282). PARATYPE

See No. 18392.

18555. *Cœloptychium rude* von Seebach (p. 332). PLESIOTYPE

See No. 18411.

The specimen in the collection comes from the same horizon and locality as did von Seebach's holotype and type material and, since Schrammen used it for further illustration of the species, it is a plesio-type, but one of greater value than most plesiotypes.

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¹Seventeen specimens which are not types are included in the collection in order to give as complete a zoological representation as possible. The specimens in most cases are identified *con/* or *affine*. In other cases, when types of a species were lacking from any locality, specimens identified by Schrammen have been included whenever available.

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ABBREVIATIONS FOR NAMES OF PERIODICALS USED IN THE BIBLIOGRAPHY

- A** bh. d. könig. böhm. Gesell. d. Wiss.—Abhandlungen der königlichen böhmischen Gesellschaft der Wissenschaften.
- A** bh. d. könig.-preuss. geol. Landesanst.—Abhandlungen der königlich-preussischen geologischen Landesanstalt.
- A** bh. d. math.-naturwiss. Cl. d. könig. böhm. Gesell. d. Wiss.—Abhandlungen der mathematisch-naturwissenschaftlichen Classe der königlichen böhmischen Gesellschaft der Wissenschaften.
- A** bh. d. math.-phys. Cl. d. könig.-bayer. Akad. d. Wiss.—Abhandlungen der mathematisch-physicalischen Classe der königlich-bayerischen Akademie der Wissenschaften.
- Ann. and Mag. Nat. Hist.—Annals and Magazine of Natural History.
- Archiv der naturw. Landesdurchforschung von Böhmen.—Archiv der naturwissenschaftlichen Landesdurchforschung von Böhmen.
- Bull. Acad. Imp. Sci. de St. Péters.—Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg.
- Bull. Soc. Belge de Géol.—Bulletin de la Société Belge de Géologie de Paléontologie et d'Hydrologie.
- Bull. Soc. Imp. d. Nat. de Mosc.—Bulletin de la Société Impériale des Naturalistes de Moscou.
- Centralbl. f. Min., Geol., u. Pal.—Centralblatt für Mineralogie, Geologie und Palaeontologie.
- Jahr. d. k. k. geol. Reichsanstalt.—Jahrbuch der kaiserlich-königlichen geologischen Reichsanstalt.
- Mag. Nat. Hist.—Magazine of Natural History.
- Mém. de l'Acad. imp. d. Sci. de St. Pétersb.—Mémoires de l'Académie impériale des Sciences de St. Pétersbourg.
- Mém. de la Soc. Géol. de France.—Mémoires de la Société géologique de France.
- Neues Jahrb. f. Min.—Neues Jahrbuch für Mineralogie, Geognosie, Geologie und Petrefakten-Kunde, in recent years, Neues Jahrbuch für Mineralogie, Geologie und Palaeontologie.
- Q. J. G. S.—Quarterly Journal of the Geological Society of London.
- Sitz. d. math. naturw. Cl. d. kaiser. Akad. d. Wiss.—Sitzungsberichte der mathematisch-naturwissenschaftlichen Classe der kaiserlichen Akademie der Wissenschaften.
- Sitz. d. niederrh. Gesell. in Bonn.—Sitzungsberichte der niederrheinischen Gesellschaft in Bonn, in Verhandlungen der naturhistorischen Vereines der preussischen Rheinlande und Westphalens.
- Sitz. d. niederrh. Gesell. f. Natur-u. Heilk. in Bonn.—Sitzungsberichte der niederrheinischen Gesellschaft für Natur-und Heilkunde in Bonn.
- Sitz. kön. böhm. Ges. Wiss.—Sitzungsberichte der königlichen böhmischen Gesellschaft zu Wissenschaft.
- Trans. Geol. Soc. London.—Transactions of the Geological Society of London.
- Verhand. d. naturhist. Ver. d. preuss. Rhein. und Westph.—Verhandlungen des naturhistorischen Vereines der preussischen Rheinlande und Westphalens.
- Zeit. f. wissensch. Zool.—Zeitschrift für wissenschaftliche Zoologie.
- Zeit. d. d. geol. Gesell.—Zeitschrift der deutschen geologischen Gesellschaft.

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¹This bibliography contains references to the literature on Cretaceous Silicispongiae and on European Cretaceous stratigraphy. Papers on the Calcispongiae and on sponges of periods other than the Cretaceous have not been included unless they contained general discussions on classification or structure and have been used by the author in writing this paper. References preceded by an asterisk (*) have not been consulted, because not available. Only the more important stratigraphic references have been included, because the present paper deals only incidentally with the stratigraphy.

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1892. Ueber Spongien aus der oberen Kreide Frankreichs in dem k. mineralogischen Museum in Dresden. Mit Vorwort von H. B. Geinitz. Mittheilungen aus dem koeniglichen mineralogisch-geologischen und Praehistorischen Museum in Dresden, Cassel, Heft 11, 26 pages, 4 plates. (34 species (11 new) described from the Senonian of Meaulne in the department of Maine-et-Loire, France.)
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- RAUFF, HERMANN. 1893-1894. Palæospongiologie. Erster Theil und Zweiter Theil, erste Hälfte, Palæontographica, Stuttgart. (Contains a bibliography of 650 references for sponges of all geological periods; best historical discussion and criticism of literature that there is in print, pp. 46-114; morphology of sponges, pp. 115-185; systematic part deals only with Palæozoic sponges; classification of sponges, p. 188, division into two classes, Silicea and Calcareae, used.)
- REUSS, AUGUST EMANUEL VON. 1840. Geognostische Skizzen aus Böhmen. Bd. I. Die Umgebung von Teplitz und Bilin in Beziehung auf ihre geognostischen Verhältnisse. Ein Betrag zur Physiographie des Böhmisches Mittlegebirges, pp. xx, 298, 9 plates (1 colored), 1 map colored.
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- 1845-1846. Die Versteinerungen der böhmischen Kreideformation. Stuttgart. 4to. 148 pp. [IV.] 51 plates. (Sponges described, pp. 70-80.)
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- 1864b. Die Quadraten-Kreide des Sudmerberges bei Goslar. Palæontographica, Cassel, XIII, (1864-1866), pp. 193-199, Pl. XXXII, figs. 1, 2. (8 species listed and 4 new ones described: *Cribrospongia scripta*, *Siphonocelia imbricata*, *Amorphospongia conifera*, *A. siliqua*.)
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1874. Der Emscher Mergel. Vorläufige Notiz über ein zwischen Cuvieri. Pläner und Quadraten-Kreide lagerndes mächtiges Gebirgs-glied. Zeit. d. d. geol. Gesell., Berlin, XXVI, pp. 775-782. (Stratigraphic paper; sponges mentioned incidentally.)
- 1876a. Cephalopoden der oberen Kreide. Paläontographica, Cassel, XXIV, Lieferungen, 1, 2, 3, 4, pp. 1-144. (Stratigraphic discussion in Theil II, pp. i-vii, 88-134.)
- 1876b. Verbreitung der Cephalopoden in der oberen Kreide Norddeuschlands. Zeit. d. d. geol. Gesell., Berlin, XXVIII, pp. 457-518. (Stratigraphic paper giving detailed zonal classification of Upper Cretaceous on basis of ammonites; other fossils also given; sponges on pp. 506, 508, 510.)
- 1876c. Verbreitung der Cephalopoden in der oberen Kreide Norddeuschlands. Verhand. d. naturhist. Ver. d. preuss. Rhein. und Westph., Bonn, Jahrgang 33, pp. 330-406. (Practically a reprint of the paper of same title, see above 1876b. Some generic revision.)
1877. Ueber das Vorkommen der Gattung *Cœloptychium* im südlichen Europa. Sitz. d. niederrh. Gesell. f. Natur-u. Heilk. in Bonn, in Verhandl. d. naturhist. Ver., Jahrgang, 34 p. 191. (Occurrence of specimens of *Cœloptychium decimum* noted.)
1895. Ueber einige Spongien aus der Kreide Westphalens. (Vorläufige Notiz.) Zeit. d. d. geol. Gesell., Berlin, XLVII, pp. 194-210. (Discussion of synonymy of *Scyphia sacki* Goldf.; one new species described from the Emscher, seven new species from the Cœloptychium-Kreide.)
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- 1912-1913. Die Löwenberger Kreide und ihre Fauna. Palaeontographica Stuttgart, Supplement-Band VI, 275 pages, 15 plates. (Sponges listed, p. 75; eleven species (three new) described, pp. 259-266, Pl. xv, figs. 1, 3; important correlation tables, sections, map.)
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- 1876b. On *Eubrochus clausus*, a Vitreo-hexactinellid Sponge from the Cambridge "Coprolite" bed. Geol. Mag., London, New Ser., Dec. 2, III, pp. 398-403, Pl. XIV. (Microscopic characteristics discussed.)
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1863. Ueber die Kreide am Zeltberg bei Lüneburg. Zeit. d. d. geol. Gesell., Berlin, XV, pp. 97-187, geol. map Pl. iv. (Stratigraphic and palaeontologic; comparative table of subdivisions of Upper Cretaceous by A. Roemer, Geinitz and Strombeck, p. 186; no sponges listed or described.)
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- 1879a. Studien über fossile Spongien. Dritte Abtheilungen: Monactinellidæ, Tetractinellidæ und Calcispongien. Abh. d. math.-phys. Cl. d. könig.-bayer. Akad. d. Wiss., München, XIII, Abth. 2, (1880), pp. 3-48, Pls. XI, XII.

- 1879b. Beiträge zur Systematik der fossilen Spongien. Dritter Theil. Monactinellidæ. Neues Jahrb. f. Min., Stuttgart, Jahrgang 1879, pp. 1-40, Pls. I, II.
- 1879c. Zusatz zu dem Aufsatz von H. Woeckener: Ueber das Vorkommen von Spongien im Hilssandstein. Zeit. d. deut. geol. Gesell., Berlin, XXXI, pp. 665-667. (Generic identifications given for some of spicules noted by Woeckener (1879) in Hilssandstein.)
1882. Notizen über fossile Spongien. Neues Jahrb. f. Min., Stuttgart, Jahrgang 1882, II, pp. 203-204, (Short notice on Hinde's contribution on *Verticillites d'orbigny*; possibility of the determination of the Pharetronen as *Calcispongiae*; no new species.)
1913. Text-Book of Paleontology. Edited by Charles R. Eastman. London. (Sponges on pp. 46-74.)
1915. Grundzüge der Paläontologie. Edited and revised by Broili. Stuttgart. (Siliceous sponges on pp. 58-78. The discussion of the sponges is revised and differs considerably from that in the Eastman edition; many new and greatly improved illustrations are included.)

PLATE I

Types of Spicules in the Silicispongiæ

- Fig. 1. Oxytrioid ($\times 50$). (After Rauff, 'Palæospongiologie,' Fig. 5a.)
Fig. 2. Tripod ($\times 40$). (After Rauff, 'Palæospongiologie,' Fig. 5k.)
Fig. 3. Caltrop from *Propachastrella primæva* (von Zittel) ($\times 16$). (After Schrammen, 'Kieselpongien,' Text Plate I, fig. 4.) a. Oxycaltrops. b. Caltrop with globular arms.
Fig. 4. Criccaltrop ($\times 80$). (After Rauff, 'Palæospongiologie,' Fig. 6b.)
Fig. 5. Protriæne from *Tetillopsis longitridens* Schrammen ($\times 16$). (After Schrammen, 'Kieselpongien,' Text Plate I, fig. 7a.)
Fig. 6. Orthotriæne from *Theneopsis steinmanni* (von Zittel) ($\times 16$). (After Schrammen, 'Kieselpongien,' Text Plate I, fig. 5a.)
Fig. 7. Anatriæne from *Theneopsis steinmanni* (von Zittel) ($\times 16$). (After Schrammen, 'Kieselpongien,' Text Plate I, fig. 5b.)
Fig. 8. Dichotriæne from epiderm of *Phymatella bulbosa* (von Zittel) ($\times 30$). (After Schrammen, 'Kieselpongien,' Text Plate IV, fig. 8c.)
Fig. 9. Didichotriæne ($\times 25$). (After Rauff, 'Palæospongiologie,' Fig. 7i.)
Fig. 10. Trichotriæne ($\times 100$). (After Rauff, 'Palæospongiologie,' Fig. 7g.)

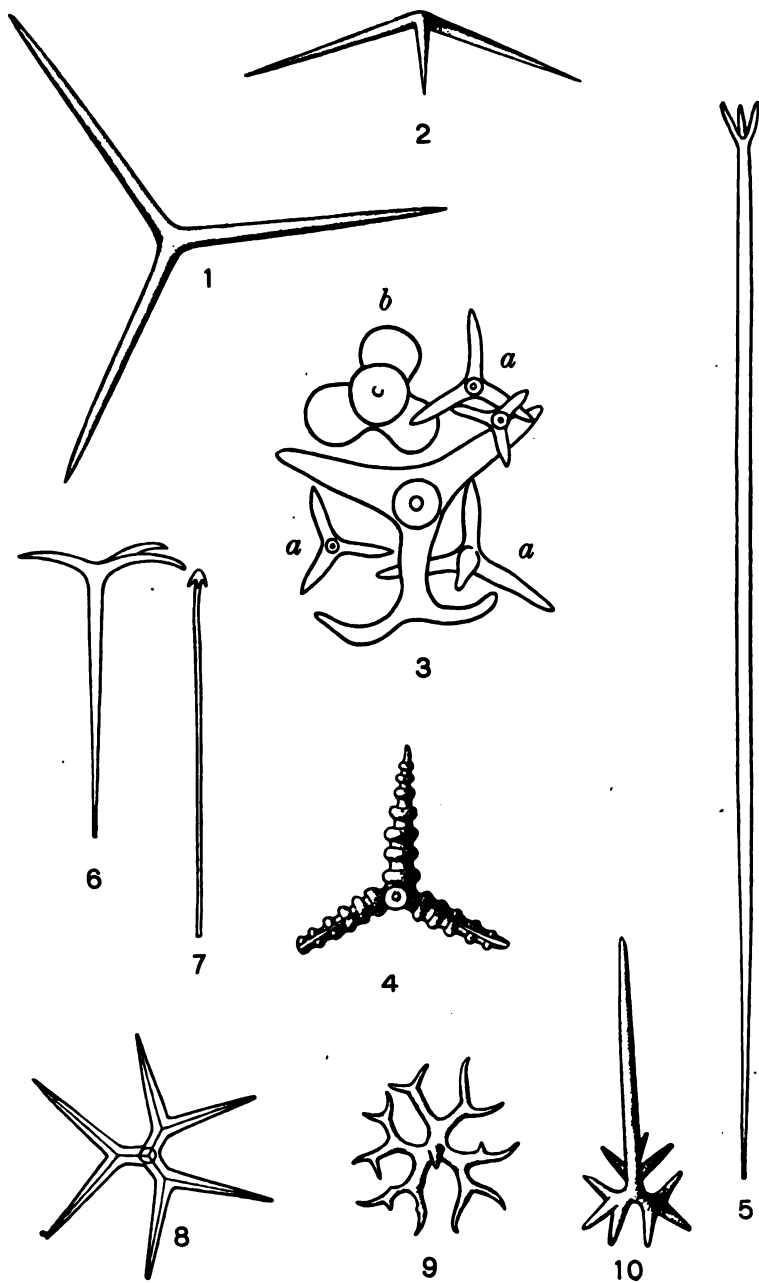


PLATE II

Types of Spicules in the Silicispongiae

- Fig. 1. Phyllotriæne from *Rhagadinia rimosa* (Roemer) ($\times 30$). (After Schrammen, 'Kieselspongien,' Text Plate v, fig. 3c.)
- Fig. 2. Symphyllotriæne ($\times 95$). (After Rauff, 'Palæospongiologie,' Fig. 8b.)
- Fig. 3. Pinakid ($\times 100$). (After Rauff, 'Palæospongiologie,' Fig. 9b.)
- Fig. 4. Amphitriæne ($\times 800$). (After Rauff, 'Palæospongiologie,' Fig. 10a.)
- Fig. 5. Candelaber ($\times 1000$). (After Rauff, 'Palæospongiologie,' Fig. 13.)
- Fig. 6. Tetracclone from *Jerea quenstedti* von Zittel ($\times 30$). (After Schrammen, 'Kieselspongien,' Text Plate iv, fig. 2a.)
- Fig. 7. Dichotrider ($\times 65$). (After Rauff, 'Palæospongiologie,' Fig. 19.)
- Fig. 8. Ennomoclone ($\times 120$). (After Rauff, 'Palæospongiologie,' Fig. 20.)
- Fig. 9. Didymoclone ($\times 120$). (After Rauff, 'Palæospongiologie,' Fig. 22.)
- Fig. 10. Diceranoclone from *Pachinion cylindricum* Schrammen ($\times 30$). (After Schrammen, 'Kieselspongien,' Text Plate iii, fig. 4a.)

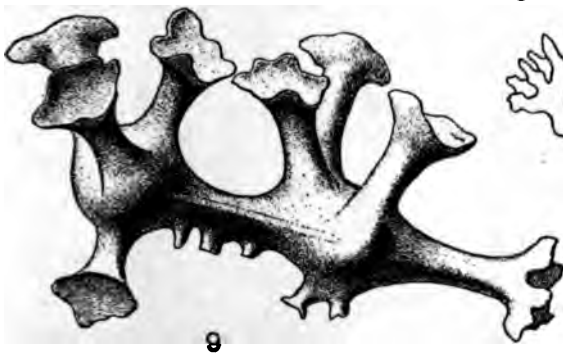
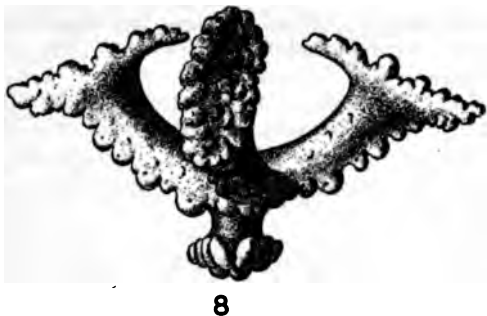
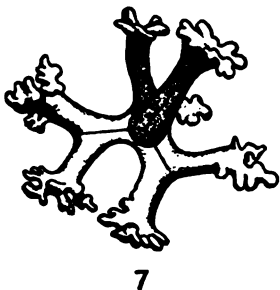
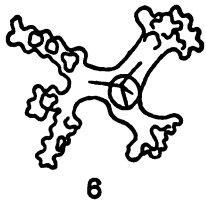
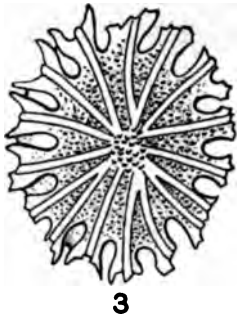
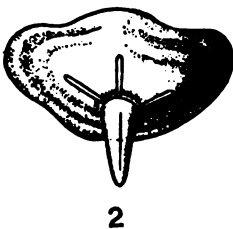
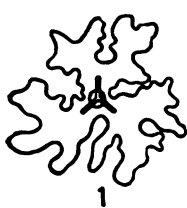


PLATE III

Types of Spicules in the Silicispongiae

- Fig. 1. Rhabdoclone ($\times 75$). (After Rauff, 'Palæospongiologie,' Fig. 23.)
- Fig. 2. Megaclone from *Heterostinia obliqua* (Benett) ($\times 16$). (After Schrammen, 'Kiesel-spongien,' Text Plate II, fig. 4a.)
- Fig. 3. Rhizoclone from *Verruculina macrommata* (Roemer) ($\times 20$). (After Schrammen, 'Kiesel-spongien,' Text Plate VIII, fig. 6.)
- Fig. 4. Megarhizoclone from *Chalaropegma cerebriformis* Schrammen ($\times 16$). (After Schrammen, 'Kiesel-spongien,' Text Plate VIII, fig. 8.)
- Fig. 5. Megarhizoclonid from *Phalangium scytaliforme* Schrammen ($\times 30$). (After Schrammen, 'Kiesel-spongien,' Text Plate III, fig. 2b.)
- Fig. 6. Sphaeroclone from *Pachytrachelus exspectatus* Schrammen ($\times 50$). (After Schrammen, 'Kiesel-spongien,' Text Plate VIII, fig. 1f.)
- Fig. 7. Heloclone from *Pachycothon giganteum* (Roemer) ($\times 16$). (After Schrammen, 'Kiesel-spongien,' Text Plate VIII, fig. 3a.)
- Fig. 8. Hexactine (dictyonal hexactines) from *Stereochlamis pilosa* Schrammen ($\times 45$). (After Schrammen, 'Kiesel-spongien,' Text Plate IX, fig. 9.)
- Fig. 9. Oxyhexactine ($\times 100$). (After Rauff, 'Palæospongiologie,' Fig. 28a.)
- Fig. 10. Strongylhexactine ($\times 100$). (After Rauff, 'Palæospongiologie,' Fig. 28c.)
- Fig. 11. Tylhexactine ($\times 100$), with sixth arm nearly aborted, approaching Tylpentactine. (After Rauff, 'Palæospongiologie,' Fig. 28 l.)
- Fig. 12. Discohexactine ($\times 300$). (After Rauff, 'Palæospongiologie,' Fig. 29a.)
- Fig. 13. Pinule (Pinulhexactine) ($\times 100$). (After Rauff, 'Palæospongiologie,' Fig. 31b.)

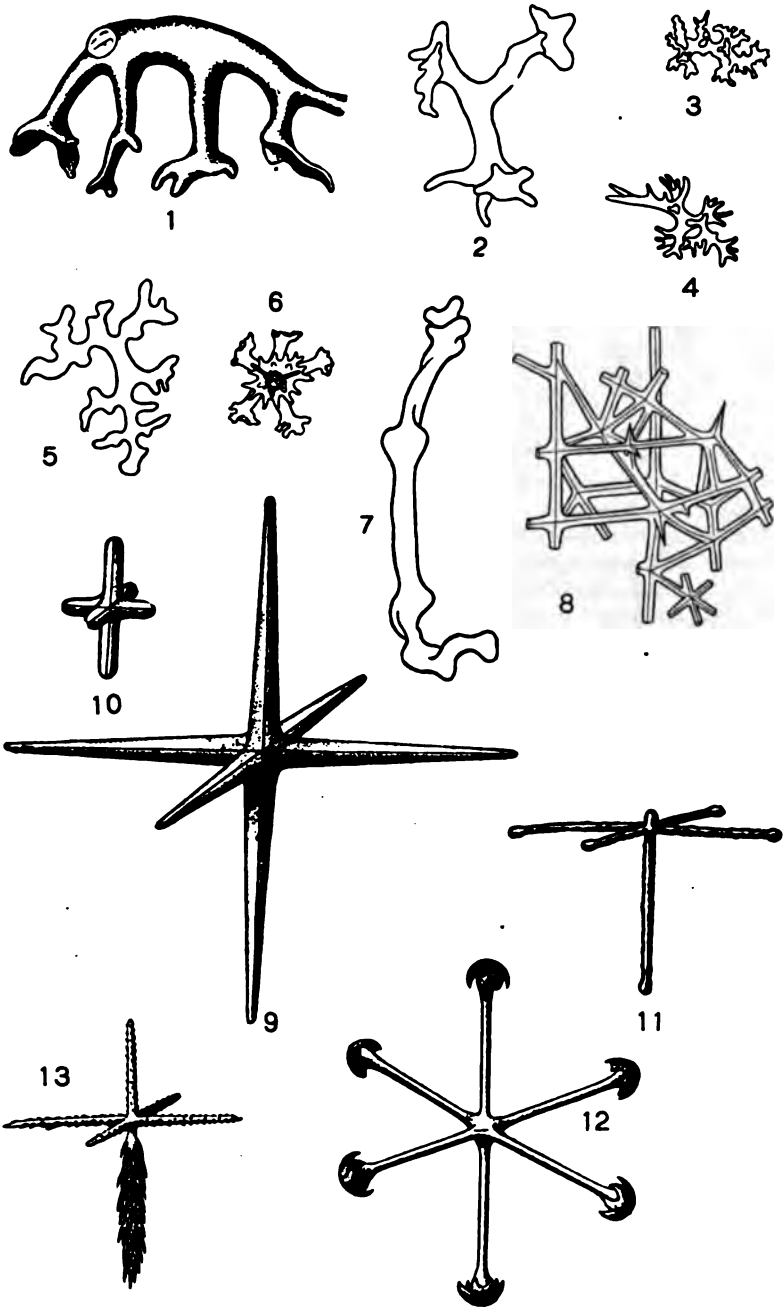


PLATE IV

Types of Spicules in the Silicispongiæ

- Fig. 1. Tylhexaster ($\times 300$). (After Rauff, 'Palæospongiologie,' Fig. 29c.)
Fig. 2. Graphihexaster ($\times 300$). (After Rauff, 'Palæospongiologie,' Fig. 29f.)
Fig. 3. Discohexaster ($\times 450$). (After Rauff, 'Palæospongiologie,' Fig. 30.)
Fig. 4. Floricom ($\times 300$). (After Rauff, 'Palæospongiologie,' Fig. 29g.)
Fig. 5. Plumicom ($\times 300$). (After Rauff, 'Palæospongiologie,' Fig. 28x.)
Fig. 6. Lychnisks from *Toulminia wollemanni* Schrammen ($\times 45$). (After Schrammen, 'Kieselspongien,' Text Plate xv, fig. 6.)
Fig. 7. Pentactine ($\times 1$). (After Rauff, 'Palæospongiologie,' Fig. 28m.)
Fig. 8. Pinule (Pinulpentactine ($\times 300$)). (After Rauff, 'Palæospongiologie,' Fig. 31a.)
Fig. 9. Tetractine (Stauractine) ($\times 100$). (After Rauff, 'Palæospongiologie,' Fig. 29 l.)
Fig. 10. Amphidisc ($\times 10$). (After Rauff, 'Palæospongiologie,' Fig. 32.)
Fig. 11. Amphiaster ($\times 250$). (After Rauff, 'Palæospongiologie,' Fig. 29i.)
Fig. 12. Uncin ($\times 300$). (After Rauff, 'Palæospongiologie,' Fig. 31h.)
Fig. 13. Scopula ($\times 450$). (After Rauff, 'Palæospongiologie,' Fig. 31d.)
Fig. 14. Clavula ($\times 450$). (After Rauff, 'Palæospongiologie,' Fig. 31f.)

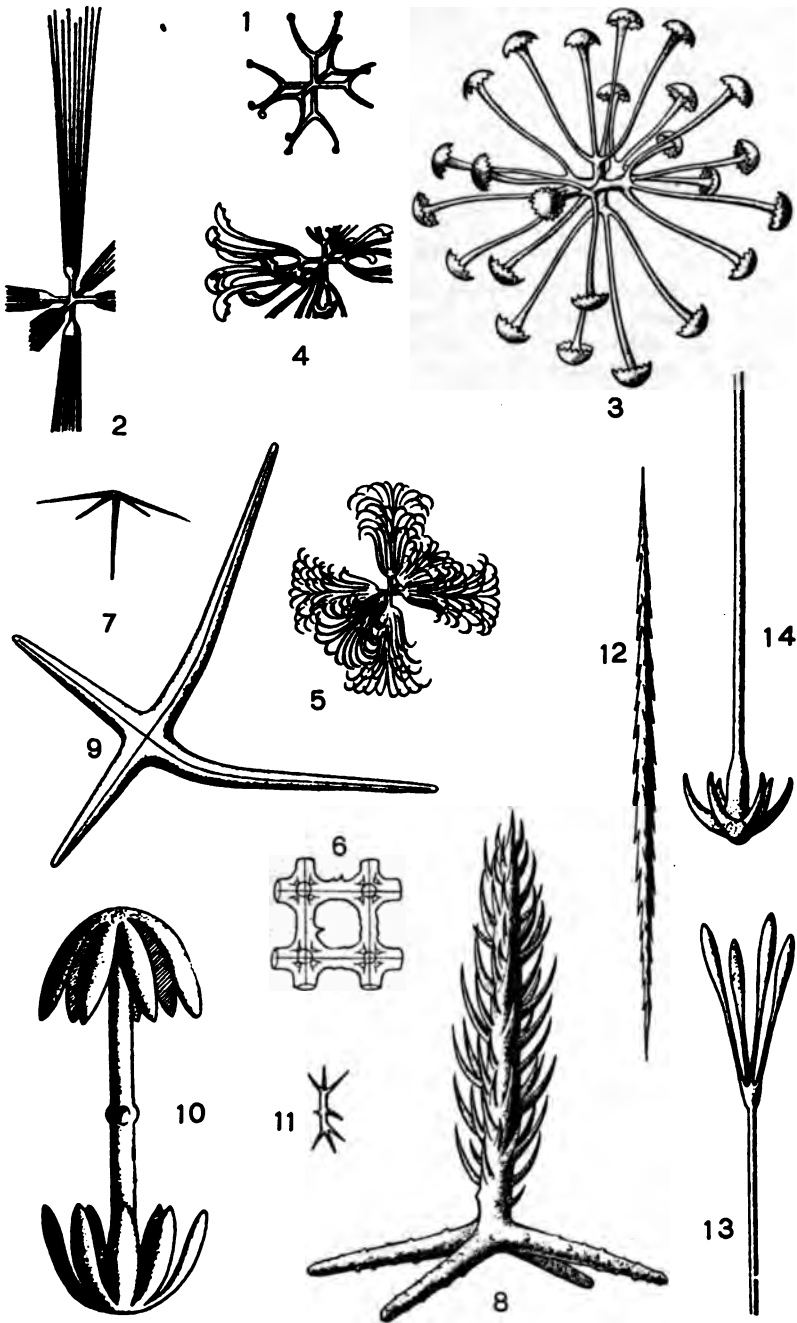


PLATE V

Types of Spicules in the Silicispongiæ

- Fig. 1. Amphiox from *Ophiraphidites infundibuliformis* Schrammen ($\times 16$). (After Schrammen, 'Kiesel-spongien,' Text Plate vii, fig. 5c.)
- Fig. 2. Amphitorn ($\times 100$). (After Rauff, 'Palæospongiologie,' Fig. 34f.)
- Fig. 3. Dor ($\times 300$). (After Rauff, 'Palæospongiologie,' Fig. 34g.)
- Fig. 4. Amphistrongyle from *Alloioraphium spongiosum* Schrammen ($\times 16$). (After Schrammen, 'Kiesel-spongien,' Text Plate vii, fig. 4d.)
- Fig. 5. Style from *Cephaloraphidites milleporatus* Schrammen ($\times 16$). (After Schrammen, 'Kiesel-spongien,' Text Plate vii, fig. 3b.)
- Fig. 6. Tylostyle from *Alloioraphium spongiosum* Schrammen ($\times 16$). (After Schrammen, 'Kiesel-spongien,' Text Plate vii, fig. 4b.)
- Fig. 7. Amphityle from *Alloioraphium spongiosum* Schrammen ($\times 16$). (After Schrammen, 'Kiesel-spongien,' Text Plate vii, fig. 4c.)
- Fig. 8. Ophirhabd from *Megaloraphium auriforme* Schrammen ($\times 16$). (After Schrammen, 'Kiesel-spongien,' Text Plate vii, fig. 7a.)
- Fig. 9. Cricamphityle ($\times 80$). (After Rauff, 'Palæospongiologie,' Fig. 35b.)
- Fig. 10. Spirule ($\times 300$). (After Rauff, 'Palæospongiologie,' Fig. 35m.)
- Fig. 11. Sigmaspire ($\times 290$). (After Rauff, 'Palæospongiologie,' Fig. 35n.)
- Fig. 12. Diancistra ($\times 180$). (After Rauff, 'Palæospongiologie,' Fig. 35f.)
- Fig. 13. Anisochela ($\times 360$). (After Rauff, 'Palæospongiologie,' Fig. 35c.)
- Fig. 14. Isochela ($\times 100$). (After Rauff, 'Palæospongiologie,' Fig. 35d.)
- Fig. 15. Diaspid ($\times 1350$). (After Rauff, 'Palæospongiologie,' Fig. 35e.)
- Fig. 16. Sanidaster ($\times 100$). (After Rauff, 'Palæospongiologie,' Fig. 35 o.)
- Fig. 17. Spiraster ($\times 500$). (After Rauff, 'Palæospongiologie,' Fig. 36a.)
- Fig. 18. Discorhabd ($\times 280$). (After Rauff, 'Palæospongiologie,' Fig. 35h.)
- Fig. 19. Sphær ($\times 430$). (After Rauff, 'Palæospongiologie,' Fig. 36b.)
- Fig. 20. Euaster (Oxyaster) ($\times 100$). (After Rauff, 'Palæospongiologie,' Fig. 36c.)
- Fig. 21. Sphæraster ($\times 300$). (After Rauff, 'Palæospongiologie,' Fig. 36f.)
- Fig. 22. Pynaster ($\times 600$). (After Rauff, 'Palæospongiologie,' Fig. 36g.)
- Fig. 23. Sterraster ($\times 290$). (After Rauff, 'Palæospongiologie,' Fig. 36h.)
- Fig. 24. Rhax ($\times 200$). (After Rauff, 'Palæospongiologie,' Fig. 36i.)

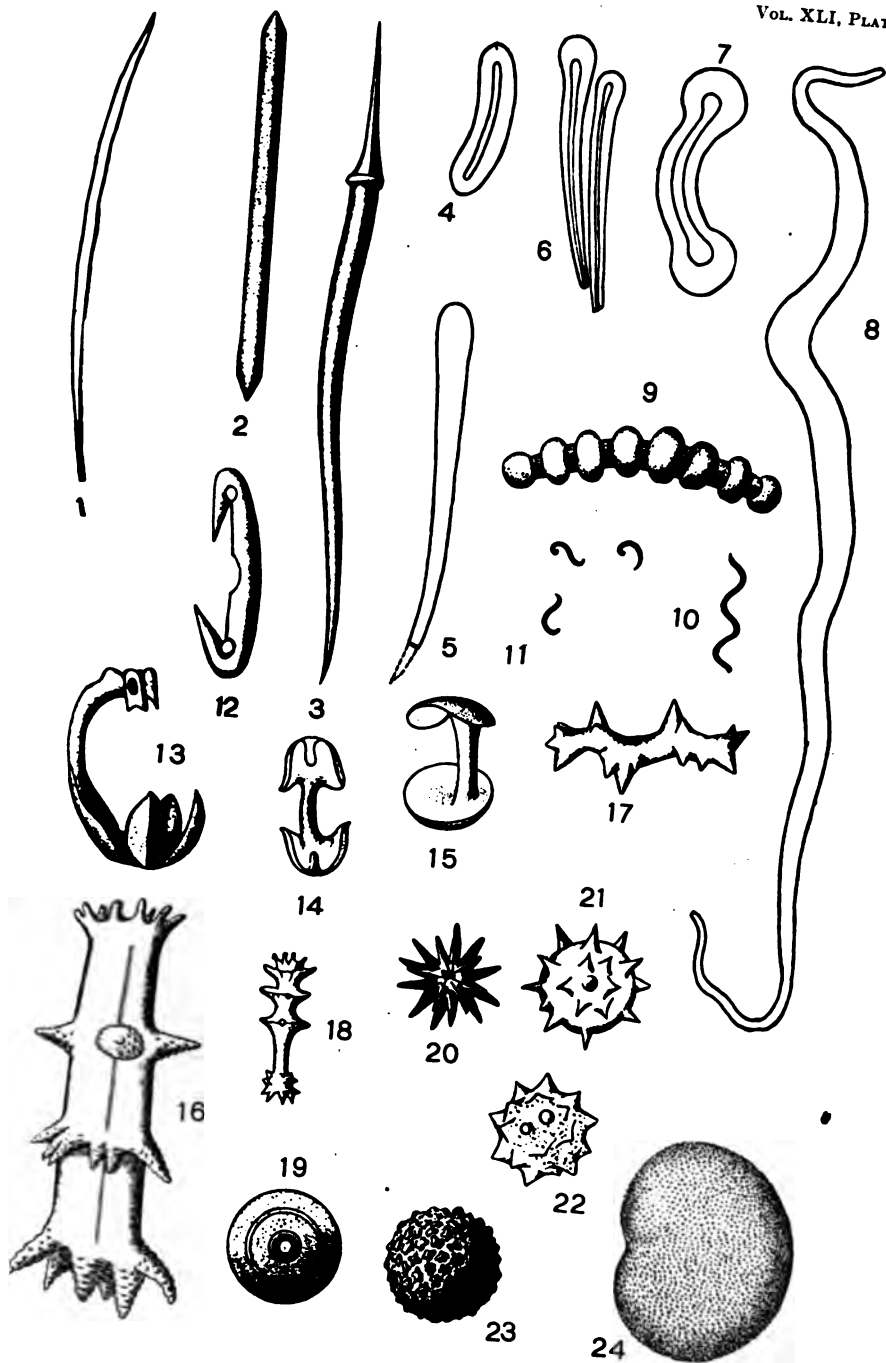


PLATE VI

Representative Associations of Skeletal Spicules in the Silicispongiae

(After Schrammen)

Order Tetraxonia¹ Schulze

Family Tetillidae Sollas

Fig. 1. *Tetillopsis longitridens* Schrammen. (a) Protriæne. (b) Amphiox. ($\times 16$) (Schrammen, 'Kieselspongien,' Text Plate I, fig. 7.) Quadratenkreide. Oberg. A. M. N. H. No. 18277.

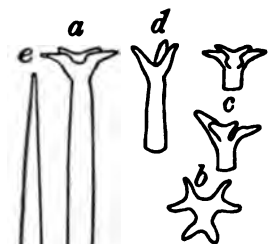
Family Stellettidæ Sollas emend. v. Lendenfeld

Fig. 2. *Stolleya ornatissima* Schrammen. (a) Dichotriæne. (b) Dichotriæne seen from above. (c) Front part of a dichotriæne. (d) Front part of a protriæne. (e) Half of an amphiox. ($\times 16$) (Schrammen, 'Kieselspongien,' Text Plate I, fig. 1.) Quadratenkreide. Oberg. A. M. N. H. No. 18278.

Family Megamorinidæ v. Zittel

Fig. 3. *Doryderma (Brochodora) roemeri* Hinde. (a) Megaclones. (b) Dermal dichotriænes. (c) Amphioxes. ($\times 16$) (Schrammen, 'Kieselspongien,' Text Plate II, fig. 1.) Quadratenkreide. Oberg. A. M. N. H. No. 18282.

¹All illustrations of skeletal elements from species of this order show the individual spicules and not the skeleton as a whole.



2



PLATE VII

Representative Associations of Skeletal Spicules in the Silicispongiae
(After Schrammen)

Family Corallistidae Sollas emend. Schrammen

Fig. 1. *Pachinion scriptum* (Roemer). (a) Dicranoclones. (b) Megarhizoclonids. (c) Siliceous bodies from the epiderm. (d) Dermal dichotriænes. (e) Rod-like needles from the epiderm. ($\times 30$) (Schrammen, 'Kiesel-spongien,' Text Plate III, fig. 1.) Quadratenkreide. Oberg. A. M. N. H. No. 18292.

Family Pachastrellidae Sollas emend. v. Lendenfeld

Fig. 2. *Propachastrella primæva* (Zittel). (a) Caltrop. (b) Caltrop with globular arms. (c) Dermal dichotriæne seen from below. ($\times 16$) (Schrammen, 'Kiesel-spongien,' Text Plate I, fig. 4.) Quadratenkreide. Oberg. A. M. N. H. No. 18295.

Family Tetracelinidae v. Zittel

Subfamily Phymatellinae Schrammen

Fig. 3. *Phymatella bulbosa* Zittel. (a) A tetracclone. (b) A young tetracclone. (c) Dichotriæne from the blanket layer or epiderm. (d; upper a misprint for d) Irregularly shaped siliceous bodies from the epiderm. ($\times 30$) (Schrammen, 'Kiesel-spongien,' Text Plate IV, fig. 8.) Quadratenkreide. Oberg. A. M. N. H. No. 18297.

Fig. 4. *Thecosiphonia postumus* Schrammen. (a) Tetracclones. (b) Irregularly shaped siliceous bodies from the epiderm. (c) Amphioxes from the epiderm. ($\times 30$) (Schrammen, 'Kiesel-spongien,' Text Plate IV, fig. 4.) Quadratenkreide. Oberg. A. M. N. H. No. 18305.

Fig. 5. *Siphonia tubulosa* (Roemer). (a) Tetracclones. (b) Siliceous bodies from the epiderm. (c) Dermal dichotriænes. ($\times 30$) (Schrammen, 'Kiesel-spongien,' Text Plate IV, fig. 11.) Quadratenkreide. Oberg. A. M. N. H. No. 18311.

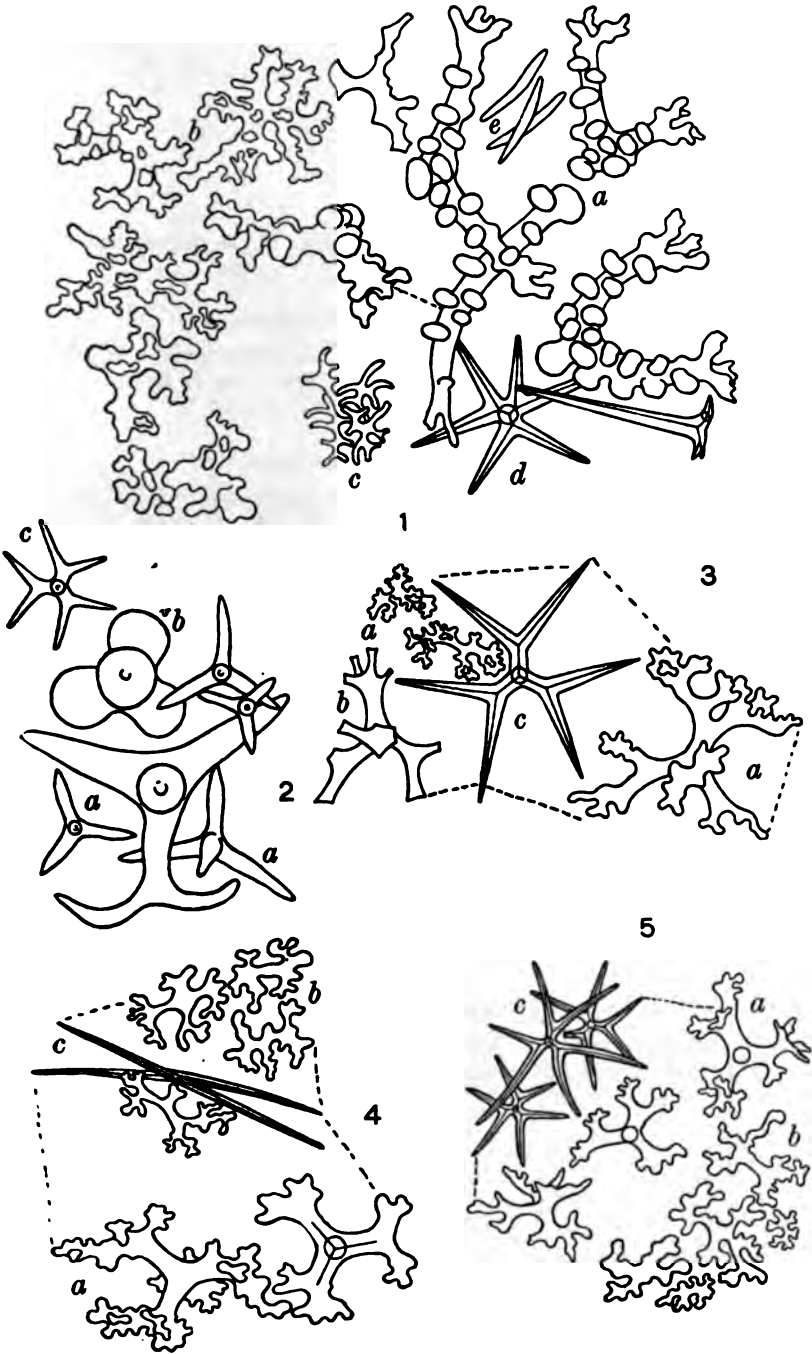


PLATE VIII

Representative Associations of Skeletal Spicules in the Silicispongiæ
(After Schrammen)

Subfamily Acrochordoniæ Schrammen

Fig. 1. *Acrochordonia ramosa* Schrammen. (a) Tetracloones. (b) Dermal dichotriænes ($\times 30$) (Schrammen, 'Kieselspongien,' Text Plate vi, fig. 10.) Quadratenkreide. Oberg. A. M. N. H. No. 18313.

Subfamily Discorderminiæ Schrammen

Fig. 2. *Discordermia antiqua* Schrammen. (a) Tetracloones with smooth arms. (b) A tetracloone with warty arms. (c) Lobate phyllotriæne from the epiderm. ($\times 30$) (Schrammen, 'Kieselspongien,' Text Plate v, fig. 4.) Quadratenkreide. Oberg. A. M. N. H. No. 18315.

Fig. 3. *Rhagadinia rimosa* (Roemer). (a) Tetracloones with warty arms. (b) A tetracloone with smooth arms. (c) A phyllotriæne from the epiderm. ($\times 30$) (Schrammen, 'Kieselspongien,' Text Plate v, fig. 3.) Quadratenkreide. Oberg. A. M. N. H. No. 18316.

Subfamily Phymaraphiniæ Schrammen

Fig. 4. *Procaliapsis cretacea* Schrammen. (a) Tetracloones. (b) Dermal phyllotriænes. ($\times 30$) (Schrammen, 'Kieselspongien,' Text Plate vi, fig. 2.) Quadratenkreide. Oberg. A. M. N. H. No. 18323.

Subfamily Astrocladiniæ Schrammen

Fig. 5. *Astrocladia subramosa* (Roemer). Tetracloones ($\times 30$). (Schrammen, 'Kieselspongien,' Text Plate vi, fig. 9.) Quadratenkreide. Oberg. A. M. N. H. No. 18324.

Subfamily Plinthoselliniæ Schrammen

Fig. 6. *Dactylotus micropella* Schrammen. (a) Tetracloones. (b) Young tetracloones. ($\times 30$) (Schrammen, 'Kieselspongien,' Text Plate vi, fig. 8.) Quadratenkreide. Oberg. A. M. N. H. No. 18326.

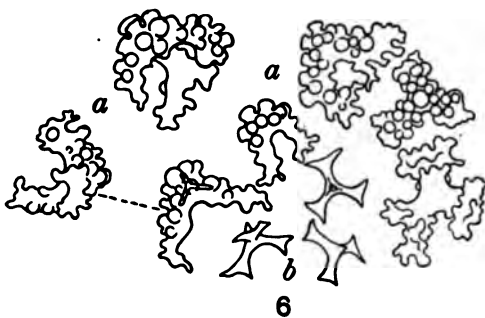
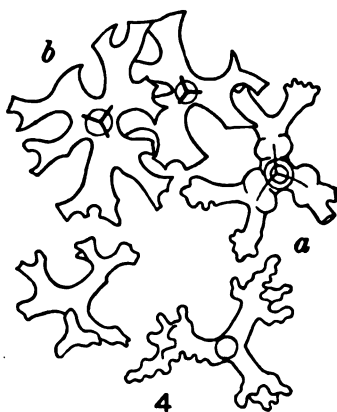
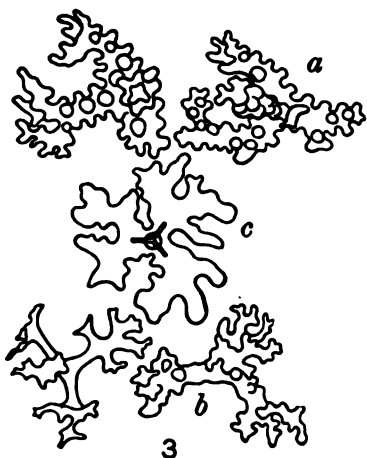
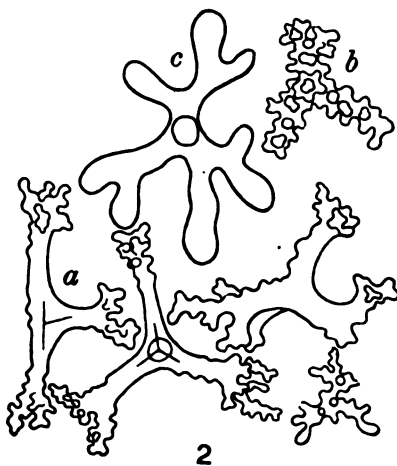
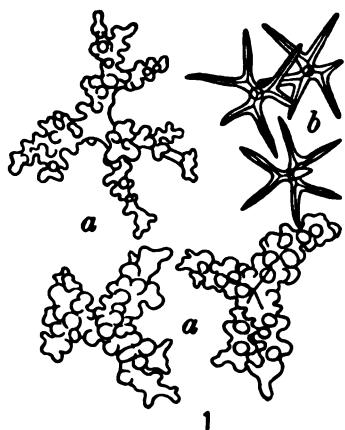


PLATE IX

Representative Associations of Skeletal Spicules in the Silicispongiae
(After Schrammen)

Family Geodiidæ Sollas

Fig. 1. *Geodeopsis microthrinax* Schrammen. (a) A protriæne. (b) An amphiox. ($\times 16$) (Schrammen, 'Kiesel-spongien,' Text Plate I, fig. 8.) Quadratenkreide. Oberg. A. M. N. H. No. 18327.

Family Ophiraphididæ Schrammen

Fig. 2. *Alloioraphium spongiosum* Schrammen. (a) Ophirhabds. (b) Tylostyles. (c; just above b; the letter was omitted on the plate) An amphistyle. (d) An amphistrongyle. (e) An amphiox. ($\times 16$) (Schrammen, 'Kiesel-spongien,' Text Plate VII, fig. 4.) Quadratenkreide. Oberg. A. M. N. H. No. 18325.

Family Helobrachiidæ Schrammen

Fig. 3. *Helobrachium consecatum* Schrammen. (a) Triactines. (b) Central part of a triactine (seen from the side, and showing the short axial canal of the fourth ray which is reduced to a globular swelling. ($\times 16$) (Schrammen, 'Kiesel-spongien,' Text Plate VII, fig. 1.) Quadratenkreide. Oberg. A. M. N. H. No. 18338.

Family Helomorinidæ Schrammen

Fig. 4. *Pachycothion giganteum* (Roemer). (a) Heloclones. (b) A dichotriæne from the surface. (c) An amphiox. ($\times 16$) (Schrammen, 'Kiesel-spongien,' Text Plate VIII, fig. 3.) Quadratenkreide. Oberg. A. M. N. H. No. 18339.

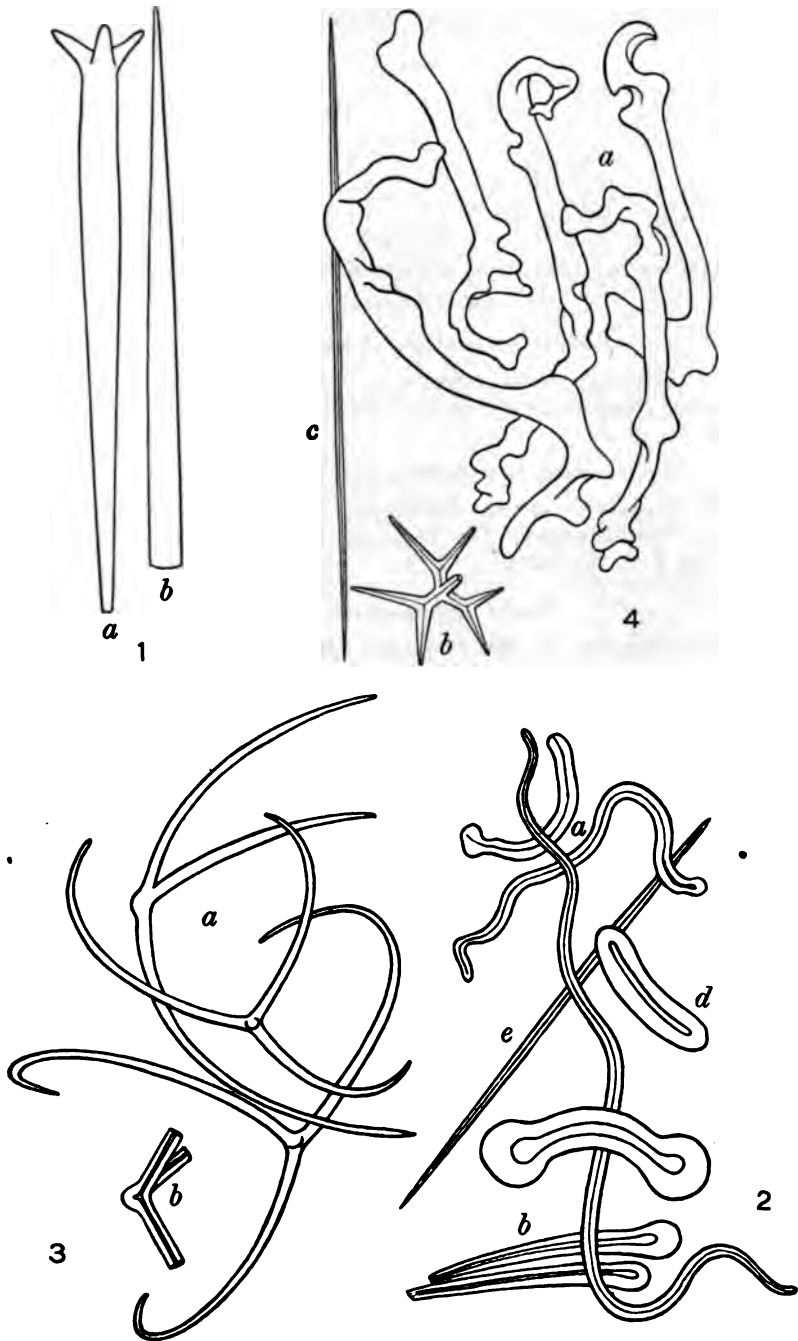


PLATE X

Representative Associations of Skeletal Spicules in the Silicispongiae
(After Schrammen)

Family Desmacidonidæ Ridley and Dendy

Fig. 1. *Rhizopsis horrida* Schrammen. Megascleres ($\times 10$). (Schrammen, 'Kieselspongien,' Text Plate VIII, fig. 11.) Quadratenkreide. Oberg. A. M. N. H. No. 18340.

Family Homoraphidæ Ridley and Dendy

Fig. 2. *Halichondria vosmaeri* Schrammen. Amphioxes from the surface ($\times 10$). (Schrammen, 'Kieselspongien,' Text Plate VIII, fig. 10.) Scaphites Pläner. Nettlingen. A. M. N. H. No. 18214.

Family Rhizomorinidæ v. Zittel

Fig. 3. *Seliscotho mantelli* (Goldfuss). Rhizoclones ($\times 20$). (Schrammen, 'Kieselspongien,' Text Plate VIII, fig. 4.) Mucronatenkreide. Misburg. A. M. N. H. No. 18527.

Family Megarhizidæ Schrammen

Fig. 4. *Chalaropegma cerebriformis* Schrammen. Megarhizoclones enlarged 16 times. For comparison, showing the difference in size, (4a) is a megacclone (4b, a rhizoclone, both enlarged 16 times. (Schrammen, 'Kieselspongien,' Text Plate VIII, fig. 8.) Mucronatenkreide. Misburg. A. M. N. H. No. 18528.

Family Sphærocladinidæ Schrammen

Fig. 5. *Pachytrachelus exspectatus* Schrammen. (a) Sphæroclones with from 1 to 5 clones ($\times 50$). (b) Two sphæroclones in juxtaposition ($\times 50$). (c) and (d) Indefinite six-armed siliceous bodies ($\times 50$). (e) Dermalia ($\times 60$). (f) A sphæroclone with the ends of the axial canals seen from above and below ($\times 50$). (g) Central part of another sphæroclone with part of the axial canals ($\times 100$). (Dotted lines are parts restored.) (Schrammen, 'Kieselspongien,' Text Plate VIII, fig. 1.) Mucronatenkreide. Misburg. A. M. N. H. No. 18529.

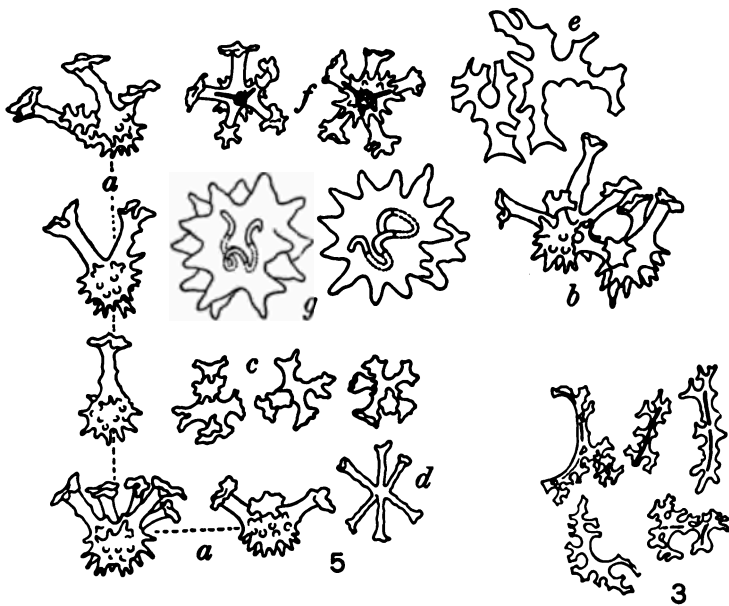
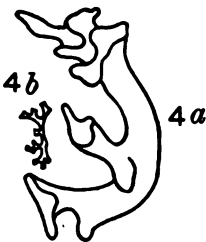
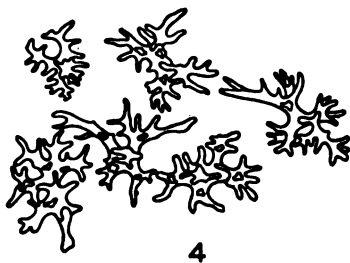
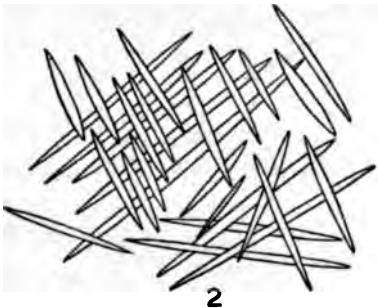
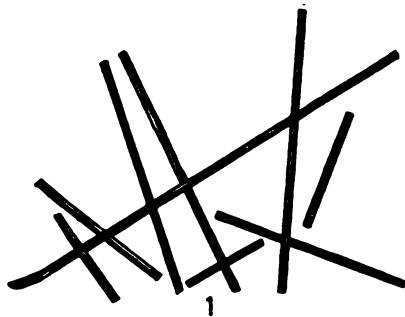


PLATE XI

Representative Associations of Skeletal Spicules in the Silicispongiae

(After Schrammen)

Order Triaxonia¹ Schulze

Family Euplectellidae Ijima

Fig. 1. *Regadrella petri-jacobi* Schrammen. Principalia with the long, thin needles of the comitalia lying thereon ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate xi, fig. 4.) Quadratenkreide. Oberg. A. M. N. H. No. 18351.

Family Euritidae F. E. Schulze

Fig. 2. *Farrea halli* Schrammen. Portion of skeleton showing lattice-like arrangement of spicules ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate xi, fig. 10.) Quadratenkreide. Oberg. A. M. N. H. No. 18353.

Family Chonelasmatidae Schrammen

Fig. 3. *Chonelasma hindii* Schrammen. Dictyonal hexactines ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate xii, fig. 1.) Quadratenkreide. Oberg. A. M. N. H. No. 18356.

Family Aphrocallistidae F. E. Schulze

Fig. 4. *Aphrocallistes cylindrodactylus* Schrammen. Surface of the outside of the skeleton seen from below ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate xi, fig. 6.) Quadratenkreide. Oberg. A. M. N. H. No. 18358.

Family Tretocalycidae F. E. Schulze

Fig. 5. *Hexactinella angustata* Schrammen. Skeletal arrangement into a dictyonal lattice or net-work ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate xi, fig. 8.) Quadratenkreide. Oberg. A. M. N. H. No. 18359.

Family Auloplacidae Schrammen

Fig. 6. *Auloplax spongiosus* Schrammen. Dictyonal hexactines ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate ix, fig. 10.) Quadratenkreide. Oberg. A. M. N. H. No. 18361.

¹All illustrations of spicules from this order show the exact arrangement of the elements as they appear in the skeleton of the sponges.

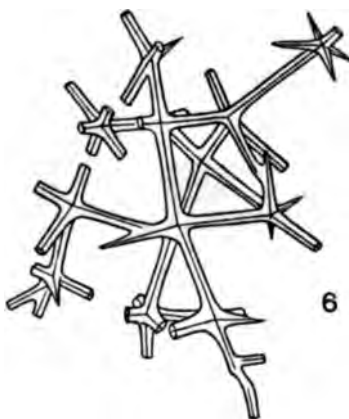
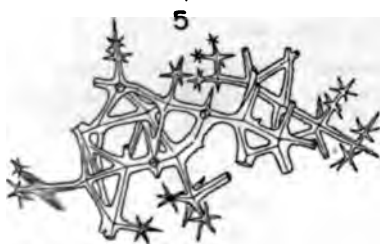
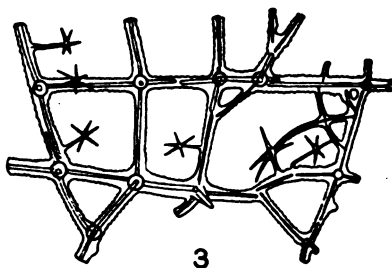
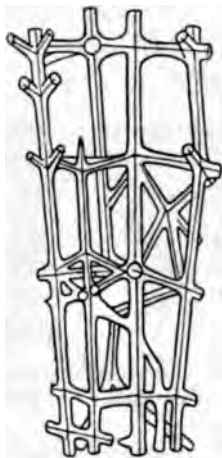
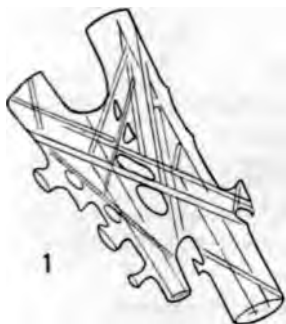


PLATE XII

Representative Associations of Skeletal Spicules in the Silicispongiae
(After Schrammen)

Family Craticularidae Rauff

Fig. 1. *Craticularia virgatula* Schrammen. Dictyonal skeleton ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate xi, fig. 9.) Quadratenkreide. Oberg. A. M. N. H. No. 18363.

Family Leptophragmidae Schrammen

Fig. 2. *Pleurostoma radiata* Roemer. Dictyonal hexactines ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate ix, fig. 4.) Quadratenkreide. Oberg. A. M. N. H. No. 18368.

Fig. 3. *Guettardia stümpeli* Schrammen. Dictyonal hexactines ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate ix, fig. 3.) Quadratenkreide. Oberg. A. M. N. H. No. 18370.

Family Callibrochidae Schrammen

Fig. 4. *Wollemannia araneosa* Schrammen. Skeletal network (*Gerüst*) ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate x, fig. 4.) Quadratenkreide. Oberg. A. M. N. H. No. 18373.

Fig. 5. *Wollemannia araneosa* Schrammen. Surface of the inside of the skeleton seen from below ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate x, fig. 5.) Quadratenkreide. Oberg. A. M. N. H. No. 18373.

Fig. 6. *Wollemannia araneosa* Schrammen. Surface of the outside of the skeleton seen from below ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate x, fig. 6.) Quadratenkreide. Oberg. A. M. N. H. No. 18373.

Family Pleurothyrisidae Schrammen

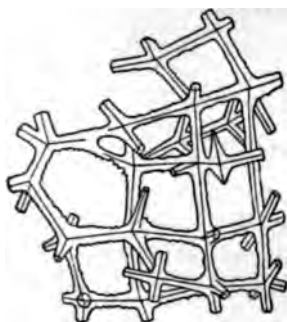
Fig. 7. *Pleurochorium schulzii* Schrammen. (a) Dictyonal hexactines. (b) Dictyoderm (*Deckgespinst*). ($\times 45$) (Schrammen, 'Kieselspongien,' Text Plate x, fig. 8.) Quadratenkreide. Oberg. A. M. N. H. No. 18374.

Family Ptychodesidae Schrammen

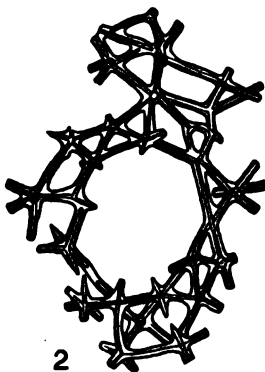
Fig. 8. *Ptychodesia papillata* Schrammen. Dictyonal hexactines ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate xi, fig. 2.) Quadratenkreide. Oberg. A. M. N. H. No. 18375.

Family Polystigmatidae Schrammen

Fig. 9. *Polystigmatium striato-punctatum* Schrammen. Dictyonal hexactines ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate x, fig. 11.) Quadratenkreide. Oberg. A. M. N. H. No. 18376.



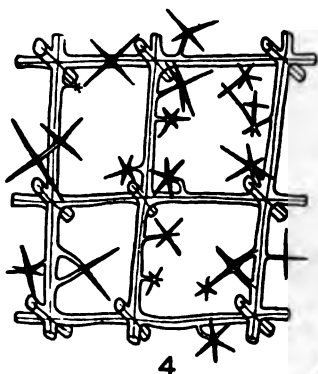
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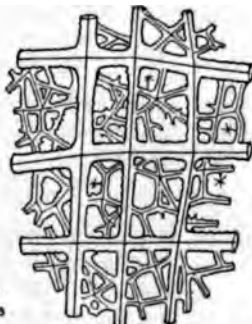
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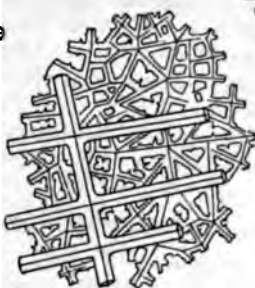
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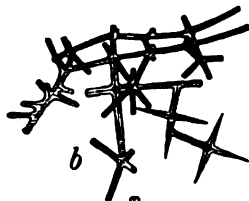
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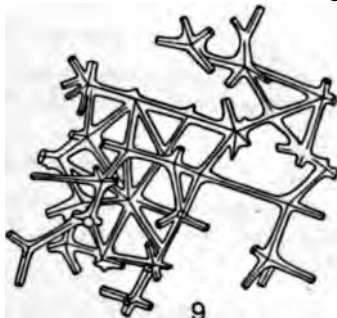


b



a

7



9

PLATE XIII

Representative Associations of Skeletal Spicules in the Silicispongiae
(After Schrammen)

Family Stichmartyceidæ Schrammen

Fig. 1. *Stichmartyx alatus* Schrammen. Dictyonal hexactines (×45). (Schrammen, 'Kieselspongien,' Text Plate ix, fig. 8.) Quadratenkreide. Oberg. A. M. N. H. No. 18377.

Family Botryosellidæ Schrammen

Fig. 2. *Botryosella labyrinthica* Schrammen. Dictyonal hexactines (×45). (Schrammen, 'Kieselspongien,' Text Plate ix, fig. 11.) Cuvieri Pläner. Grosse Heere. A. M. N. H. No. 18251.

Family Balantionellidæ Schrammen

Fig. 3. *Balantionella elegans* Schrammen. Dictyonal hexactines (×45). (Schrammen, 'Kieselspongien,' Text Plate ix, fig. 7.) Quadratenkreide. Oberg. A. M. N. H. No. 18378.

Family Ventriculitidæ v. Zittel

Fig. 4. *Ventriculites radiatus* Mantell. Dictyoderm of the upper side of the skeleton (×45). (Schrammen, 'Kieselspongien,' Text Plate xiii, fig. 5.) Cuvieri Pläner. Grosse Heere. A. M. N. H. No. 18252.

Fig. 5. *Lepidospongia fragilis* Schrammen. Dictyoderm of the inner side of the skeleton (×45). (Schrammen, 'Kieselspongien,' Text Plate xiii, fig. 1.) Quadratenkreide. Oberg. A. M. N. H. No. 18383.

Fig. 6. *Naprea striata* Schrammen. Lychnisks (×45). (Schrammen, 'Kieselspongien,' Text Plate xiv, fig. 11.) Quadratenkreide. Oberg. A. M. N. H. No. 18385.

Family Polyblastididæ Schrammen

Fig. 7. *Polyblastidium racemosum* (T. Smith). Lychnisks (×45). (Schrammen, 'Kieselspongien,' Text Plate xiii, fig. 10.) Quadratenkreide. Oberg. A. M. N. H. No. 18386.

Family Actinocyclidæ Schrammen

Fig. 8. *Actinocyclus alternans* (Roemer). Lychnisks (×45). (Schrammen, 'Kieselspongien,' Text Plate xiv, fig. 14.) Quadratenkreide. Oberg. A. M. N. H. No. 18387.

Family Microblastididæ Schrammen

Fig. 9. *Microblastidium decurrens* Schrammen. Lychnisks (×45). (Schrammen, 'Kieselspongien,' Text Plate xv, fig. 15.) Quadratenkreide. Oberg. A. M. N. H. No. 18388.

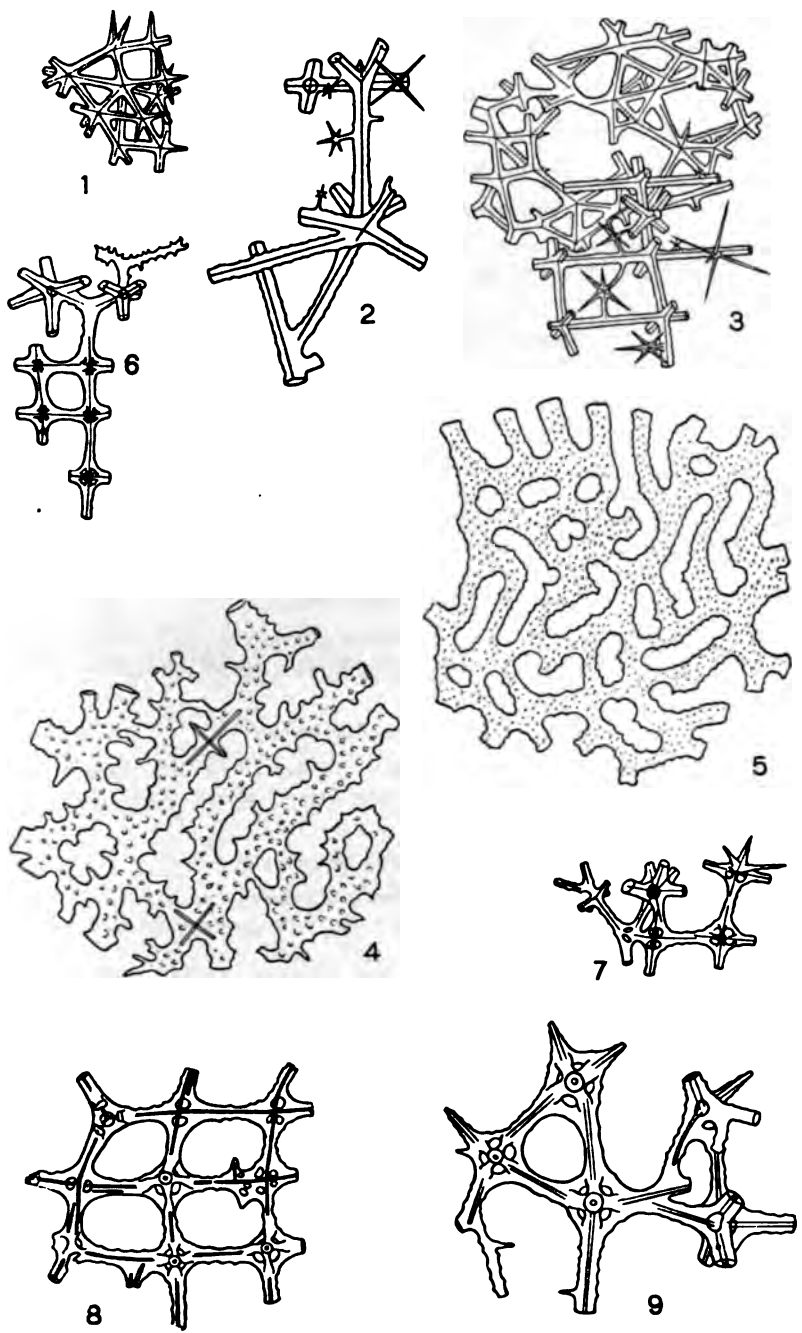


PLATE XIV

Representative Associations of Skeletal Spicules in the Silicispongiae
(After Schrammen)

Family Sporadocinidae Schrammen

Fig. 1. *Sporadocinia venosa* (Roemer). Lychniaks ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate xiv, fig. 18). Quadratenkreide. Misburg. A. M. N. H. No. 18455.

Family Callodictyonidae v. Zittel

Fig. 2. *Pleurope lacunosa* (Roemer). Epiderm of the inside and lychniaks ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate xiv, fig. 16.) Quadratenkreide. Oberg.¹

Family Coscinoporidae Schrammen

Fig. 3. *Coscinopora infundibuliformis* Goldfuss. Epiderm of the outside seen from below and lychniaks ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate xv, fig. 13.) Quadratenkreide. Oberg. A. M. N. H. No. 18395.

Family Becksiidae Schrammen

Fig. 4. *Cyclostigma mæandrina* Schrammen. Lychniaks and hexactines ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate xiv, fig. 4.) Quadratenkreide. Oberg. A. M. N. H. No. 18403.

Family Oncotæchidae Schrammen

Fig. 5. *Oncotæchus subrutus* (Quenstedt). Lychniaks ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate xiv, fig. 7.) Cuvieri Pläner. Oberg. A. M. N. H. No. 18256.

Family Camerospongidae Schrammen

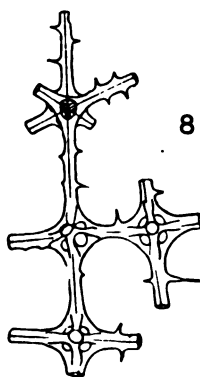
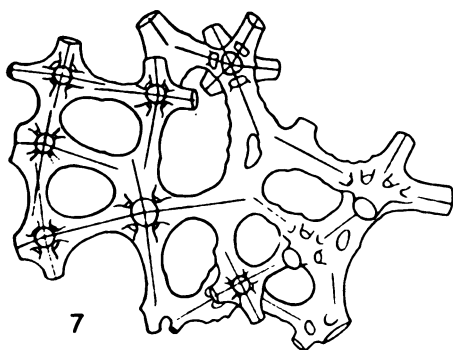
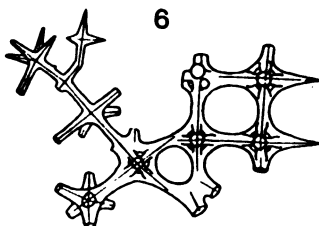
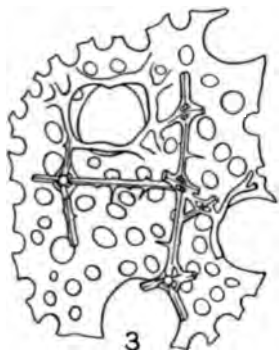
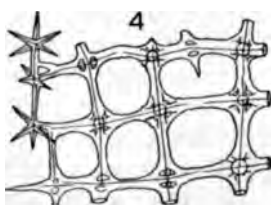
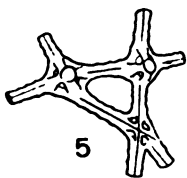
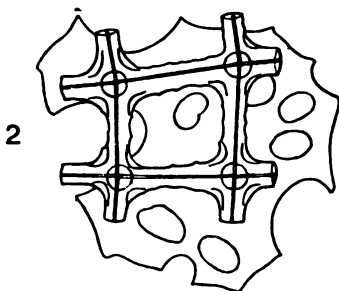
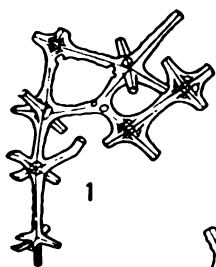
Fig. 6. *Cystispongia monostoma* Schrammen. Lychniaks and hexactines ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate xv, fig. 9.) Quadratenkreide. Oberg. A. M. N. H. No. 18404.

Fig. 7. *Tremabolites megastoma* (Roemer). Lychniaks ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate xv, fig. 8.) Quadratenkreide. Oberg. A. M. N. H. No. 18405.

Family Cæloptychidae v. Zittel

Fig. 8. *Cæloptychium rude* von Seebach. Lychniaks ($\times 45$). (Schrammen, 'Kieselspongien,' Text Plate xv, fig. 10.) Quadratenkreide. Oberg. A. M. N. H. No. 18411.

¹The only representative of this species in the collection comes from the Mucronatenkreide Misburg. (See No. 18342.)



Article II.—SIX NEW FISHES FROM NORTHWESTERN CANADA

BY FRANCIS HARPER AND JOHN TREADWELL NICHOLS

PLATE XV

A collection of fishes made by Francis Harper, while on an expedition of the Geological Survey of Canada to Great Slave Lake in 1914, has been found to comprise fifteen species, represented by approximately 120 individuals.¹ Of these, five forms are here described as new. The description of a sixth species is based upon a photograph and notes made in the field. An account of all the fishes noted will be included in a report on the biological results of the expedition.

In view of the paucity and poor condition of the material upon which previous studies of the fish fauna of the Mackenzie Basin have been made, it was to be expected that this collection would throw needed light on the relationships of various northwestern forms, but it is surprising to find in it so large a proportion of previously unknown species. A more thorough ichthyological survey of the region will undoubtedly yield many further results of interest.

Catostomus richardsoni, new species

RICHARDSON'S GRAY SUCKER; "GRAY SUCKER"

Plate XV, Figure 1

Catostomus Hudsonius RICHARDSON, 1823, Franklin's Narrative, p. 717.

Cyprinus (Catostomus) Hudsonius RICHARDSON, 1836, Fauna Boreali-Americana, III, p. 112.

Catostomus catostomus EVERMANN and GOLDSBOROUGH, 1907, Proc. Biol. Soc. Wash., XX, p. 93, part.

Moxostoma lesueurii PREBLE, 1908, N. A. Fauna No. 27, p. 504.

Type locality.—Taltson River,² at its junction with Tazin River, Mackenzie, Canada. (60° 26' 2" N., about 111° W.)

Type specimen.—Represented by photograph No. 29,996, Geological Survey of Canada, taken July 30, 1914, by Francis Harper; published herewith as Plate XV, fig. 1.

Geographic range.—Mackenzie and Winnipeg (?) Basins.

¹This collection was loaned to The American Museum of Natural History in January 1915, and there studied jointly by the authors. Publication of the present paper has been delayed on account of war conditions.

²The Taltson flows into Great Slave Lake from the south at a point about thirty miles east of the mouth of Slave River.

General characters.—Nearest to *C. commersonii*, but differing from it in the following respects: coloration more lustrous; lateral line not straight, but turned slightly dorsad over anal fin; insertion of ventrals not so far behind dorsal insertion; pectoral fins shorter; scales more crowded anteriorly; eye more posterior.

Description of type.—Total length, 510 mm.; length to base of caudal, 440 mm. Head (in latter measure) 4.07; depth 3.83. Eye (in head) 7.71; snout 1.9. Dorsal 12; anal 8. Scales 11-65-8. Papillae on lips not prominent as in *C. calostomus*. Color silvery, dark above. Fins reddish.

Remarks.—The above description was taken in the field from the fresh specimen, which was not preserved, owing to lack of adequate facilities. The photograph makes the following additional characters clear: the lateral line takes a slight upward turn over the anal fin; the posterior margin of the opercle is straighter, less convex than in *C. commersonii*; the ventrals are inserted about opposite the third dorsal ray, whereas in *commersonii* they are inserted more posteriorly, about opposite the middle of the dorsal base. A specimen at Fort Chipewyan had about 65 scales in the lateral line; and one at the mouth of the Taltson River, 64 scales.

This widely distributed fish is well known in the North as the "Gray Sucker." I saw specimens that were taken in Lake Athabaska, Tazin River, and Taltson River, and I heard of its occurrence in Salt River. Under the name of *Cyprinus (Catostomus) Hudsonius*, Richardson made the general statement that "It is a common fish in all parts of the fur countries";¹ and he commented further upon its distribution in remarking of *Cyprinus (Catostomus) Forsterianus* [= *Catostomus calostomus* (Forster)] that "North of [Great Slave Lake] it exists in greater abundance than the preceding species [*Cyprinus (Catostomus) Hudsonius* = *Catostomus richardsoni* Harper and Nichols]."² Preble recorded it (as *Moxostoma lesueurii*) from as far north as Arctic Red River.³

To Richardson belongs the credit of having discovered this species. His description⁴ of specimens of a large-scaled "Gray Sucking-carp" from Cumberland House, Saskatchewan, applies either to this or to a very closely related form; and, at any rate, the statements quoted in the preceding paragraph show that he was unquestionably familiar with the present species in the Mackenzie Basin. Though he neglected to mention the number of scales in the lateral line of this fish, he remarked concerning the scales of the "Red Sucker" (*Catostomus calo-*

¹Fauna Boreali-Americana, III, 1836, p. 112.

²Idem, p. 116.

³N. A. Fauna, No. 27, 1908, p. 504.

⁴Fauna Boreali-Americana, III, 1836, p. 113.

stomus) that they are "very considerably smaller than those of the preceding species [*C. richardsoni*],¹ . . . the difference being most apparent in the scales which cover the forepart of the back."²

In describing *Cyprinus catostomus*, Forster had before him two specimens, "the greater" of which was "very near 15 inches from the nose to the extremity of the tail",³ and this one he selected as the type.⁴ Richardson considered his *Cyprinus* (*Catostomus*) *Hudsonius* identical with Forster's type, for *Catostomus Hudsonius* LeSueur is a mere synonym of *Cyprinus catostomus* Forster.⁵ He looked upon Forster's smaller specimen, however, as a different form,⁶ referring to it as "*Cyprinus catostomus* var." in the synonymy of his *Cyprinus* (*Catostomus*) *Forsterianus*.⁷ In the former case Richardson was probably influenced by Forster's figure,⁸ which shows only about 70 scales in the lateral line of the fish. It may be assumed, however, that this was a serious inaccuracy on Forster's part,⁹ and that his name is now properly applied to the "Red Sucker," which has over 90 scales in the lateral line. In the Catalogue of the Fishes in the British Museum, VII, p. 13, under *Catostomus hudsonius* [= *C. catostomus* (Forster)], Günther remarked of specimen "a" that it was "probably one of the typical specimens examined by Forster." On this matter we have been advised by Dr. C. Tate Regan, of the British Museum, as follows: "The specimen referred to by Günther as probably one of those examined by Forster is 13 inches long and has about 100 scales in the lateral line."¹⁰ More careful examination gives a little over 13.5 in. to end of broken caudal rays. Forster described his type specimen as nearly 15 inches in total length and this may be either the type or the smaller of his two original specimens, i. e., the paratype.

It is somewhat strange that for nearly a century Richardson's "Gray Sucker" has been either disregarded or considered identical with various other species, such as *C. catostomus*, *C. commersonii*,¹¹

¹Franklin's Narrative, 1823, p. 720.

²Fauna Boreali-Americana, III, 1836, p. 116.

³Philos. Trans., LXIII, 1773, p. 156.

⁴Idem, p. 160.

⁵See LeSueur, 1817, Journal Acad. Nat. Sci. Phila., I, p. 107.

⁶Cf. Forster (*loc. cit.*, p. 155), where he quotes Mr. Graham (the collector) as saying that "there are two varieties of this fish, both of a whitish color, but one distinguished by a mixture of beautiful red." He then adds: "In the smallest of two specimens brought over, a broad stripe of red could be observed all along the *linea lateralis*."

⁷Fauna Boreali-Americana, III, 1836, p. 116.

⁸Philos. Trans., XLIII, 1773, table vi.

⁹Aside from the too small number of scales, the figure agrees fairly well with the characters of the "Red Sucker." Forster does not indicate that his two specimens represented the two different varieties, and it is quite probable that they were identical.

¹⁰In *literis*, January 28, 1916.

¹¹See synonymy of *C. texas*, in Günther, 1868, Cat. Fishes Brit. Mus., VII, p. 15.

and *Moxostoma lesueuri*. We are glad to give it the name *richardsoni* as a tribute to the memory of the able naturalist of the Franklin expeditions.

***Opsopsoodus borealis*, new species**

ATHABASKA MINNOW

Type locality.—Lake Athabaska, at Fort Chipewyan, Alberta, Canada.

Type specimen.—No. 1048, Victoria Memorial Museum; specimen in alcohol; collected June 15, 1914, by Francis Harper.

Geographic range.—Known only from the type locality.

General characters.—Referred to the genus *Opsopsoodus* because of general size, shape, markings, number of scales, and character of pharyngeal teeth. Apparently nearest to *O. bollmani*, but with different proportions and markings, ventrals inserted farther back, and maxillary longer.

Description of type.—Total length, 34 mm.; length to base of caudal, 27 mm. Head (in latter measure) 3.86; depth 4.91. Eye (in head) 3; snout 4; maxillary 4.67; interorbital 4.5. Dorsal 9; anal 9. Scales 5-37-4.

Body fusiform, moderately compressed; back not elevated; head rather large; eye large; snout shorter than eye, blunt, rounded; mouth terminal, moderately oblique; maxillary not quite reaching eye. Pharyngeal teeth (of right side), 4, crenate, hooked. Lateral line not developed. A few scales in front of ventrals the only ones evident on breast. Insertion of dorsal slightly in advance of ventrals, and slightly nearer base of caudal than snout; caudal deeply forked, 1 in head; longest dorsal ray 1.17; longest anal ray 1.56; pectorals extending .67 distance to ventrals; ventrals almost reaching anal.

Color in spirits: pale; fins with dark punctulations along rays; a dark, narrow lateral band, not as wide as pupil, from opercle to base of caudal, fainter anteriorly; body with scattered punctulations, mainly on back and sides, and especially numerous along bases of dorsal and anal; a sharply defined black blotch, about half diameter of eye, at base of caudal, partly on the fin.

Remarks.—The type and only specimen of this little minnow was taken in a hand-net as it swam along in the muddy water close to the shore at Fort Chipewyan.

***Coregonus preblei*, new species**

PREBLE'S WHITEFISH

Plate XV, Figure 2

Type locality.—Tazin River, about one mile above its confluence with the Taltson River, Mackenzie, Canada.

Type specimen.—No. 1038, Victoria Memorial Museum; head and skin, in alcohol; collected July 28, 1914, by Francis Harper.

Geographic range.—The species is known with certainty only from the type locality, but its range probably extends at least to Thluicho Lake, northern Saskatchewan, near the headwaters of the Tazin River.

General characters.—The elongate, little compressed form, the short, thick gill-rakers, and the broad preorbital place this species in the subgenus *Proscopium*.

Probably nearest to *C. quadrilateralis* (Richardson, 1823; type locality, Fort Enterprise, Mackenzie), but differing mainly in larger number of dorsal rays, more posterior insertion of dorsal, and longer snout.

Description of type.—Total length, 540 mm.;¹ length to base of caudal, 470 mm. Head (in latter measure) 5.34; depth 4.7. Eye (in head) 5.87; snout 3.38; maxillary 4; interorbital 3.14. Dorsal 14 (developed rays); anal 11 (developed rays). Scales 8-93-7; before dorsal, 33. Branchiostegals 8. Gill-rakers 6+11.

Body elongate, little compressed; back arched at nape; head pointed; profile low, nearly straight; snout projecting considerably over inferior mouth; preorbital very broad; maxillary short, broad, not reaching eye; supplemental maxillary small, .4 greatest width of maxillary; mandible reaching posterior edge of pupil; gill-rakers short and thick, their length .25 diameter of eye. Caudal peduncle long; dorsal insertion nearer snout than base of caudal, much nearer adipose than snout; longest dorsal ray barely longer than dorsal base, 1.35 in head; base of adipose a little longer than eye; caudal 1.25 in head; pectorals longer than dorsal, 1.22 in head, reaching nearly halfway to ventrals; ventrals shorter than dorsal, 1.44 in head, reaching halfway to anal; longest anal ray 1.47 in head; anal base 2 in head. Lateral line straight, scales in this row with exposed portion only half as large as in scales of adjoining rows.

Color in spirits: rather dark on sides and back, the scales with dark edges; under parts pale; dorsal with small spots, mostly on lower half; adipose spotted; caudal with a few spots, chiefly near base; other fins plain or nearly so.

Remarks.—The type specimen was picked up dead, but in good condition, as it floated in the river.

A young *Coregonus*, 95 mm. in total length, which was taken on July 2 in Thluicho Lake, northern Saskatchewan, is referable to the subgenus *Prosopium*, and probably also to the species *preblei*. A row of spots, each nearly as large as the pupil, was evident along the lateral line when the specimen was fresh, but these markings have all but disappeared in spirits.

The species is named for Mr. Edward A. Preble, of the United States Biological Survey, as a slight recognition of his very valuable contributions to our knowledge of the fauna of the Mackenzie Basin.

***Leucichthys entomophagus*,² new species**

TAZIN RIVER CISCO

Type locality.—Tazin River, at the foot of Kolethe Rapids, Mackenzie, Canada. (About 60° 38' N., about 110° 30' W.)

Type specimen.—No. 1021, Victoria Memorial Museum; specimen in alcohol; collected July 24, 1914, by Francis Harper.

¹Most of the measurements were taken in the flesh, but some of them (particularly the length) no longer apply in the shrunken skin.

²From *ἐντομίου* (insect) + *φαγῆν* (to eat).

Geographic range.—So far as known, the Tasin River, from Thainka Lake, northern Saskatchewan, to the confluence of the Tasin and Taltson Rivers, Mackenzie.

General characters.—Referable to the subgenus *Thriassomimus*,¹ which comprises species inhabiting shore waters and spawning in late autumn, and is characterized by a comparatively small mouth, short maxillary, well-developed skeleton, and firm flesh. Differs from allied northwestern forms (*lucidus*, *lauretta*, *alascanus*, and *paulus*) in the smaller number of scales.

Description of type.—Total length, 165 mm.; length to base of caudal, 137 mm. Head (in latter measure) 4.15; depth 4.15; width 2.28 in depth. Eye (in head) 4.13; snout 3.67; maxillary 2.75; interorbital 3.67. Dorsal 11 (developed rays); anal 11 (developed rays). Scales 8—about 65-7; before dorsal, 28. Branchiostegals 9. Gill-rakers 11+22.

Body elongate, compressed, of fairly robust appearance; back not elevated; ventral outline somewhat rounded; depth greatest at dorsal insertion, equal to head; head rather broad; profile low, nearly straight; maxillary reaching front of eye; supplemental maxillary about .5 greatest width of maxillary; mandible reaching middle of pupil; mouth terminal, oblique; lower jaw not projecting when mouth is closed; no distinct vertical protuberance at tip of lower jaw, or notch at tip of upper jaw, as in *athabasca*² and *macronathus*,³ gill-rakers long but not so slender as in *athabasca*, 1.6 in eye. Caudal peduncle depth 1.5 in length from last anal to first caudal rays, its length 2.36 in head; dorsal insertion midway between tip of snout and first ray of caudal; longest dorsal ray 1.5 in head; dorsal base 2.06 in head; adipose moderate in size, its length from tip to posterior end of base about .5 vertical diameter of eye; caudal 1.2 in head; pectorals nearly as long as dorsal, 1.57 in head, reaching halfway to ventrals; ventrals equal to pectorals, reaching nearly .67 distance to anal; longest anal ray 2.36 in head; anal base 2.06 in head. Lateral line straight, ascending a little at anterior end. Scales firm, regularly imbricated.

Color in spirits: upper half of body dark bluish; cheeks, opercles, and sides below lateral line with fine dark punctulations; dorsal and caudal somewhat dusky; pectorals nearly plain, ventrals and anal entirely so.

Remarks.—The specimens examined number twenty-seven, all of which were taken between July 11 and 30. The type is the largest specimen, and the next measures 87 mm. in total length. The remainder are much smaller, between 25 and 52 mm. in total length.

The type specimen was picked up dead, with a gash on its caudal peduncle, as if it had suffered an attack by some voracious pike (*Esox lucius*). It had in its stomach fragments of a good-sized caddis-fly. The name we have bestowed upon the species is a reference to its food habits, as thus indicated.

¹Cf. Jordan and Evermann, 1911, Bull. U. S. Bureau Fisheries, XXIX, p. 4.

²See *infra*, p. 269.

³See *infra*, p. 270.

***Leucichthys athabasca*, new species**

CISCO OF LAKE ATHABASKA

Type locality.—Lake Athabaska, at the mouth of Charlot River, northern Saskatchewan, Canada.

Type specimen.—No. 1020, Victoria Memorial Museum; specimen in alcohol; collected June 28, 1914, by Francis Harper.

Geographical range.—Known only from the type locality.

General characters.—Referable to the subgenus *Cisco*,¹ which, as compared with *Thriassomimus*, comprises species inhabiting deeper water and spawning in mid-summer, and is characterized by a relatively large mouth, feeble skeleton, and soft flesh. Differs from other members of subgenus except *supernas*, *johannæ*, and *prognathus* in its projecting lower jaw, and from these in smaller number of scales and narrower interorbital. Differs further from *supernas* and *prognathus* in smaller number of gill-rakers.

Description of type.—Total length, 165 mm.; length to base of caudal, 137 mm. Head (in latter measure) 4.15; depth 5.48; width 2.08 in depth. Eye (in head) 4.12; snout 3.67; maxillary 2.64; interorbital 4.71. Dorsal 11 (developed rays); anal 12 (developed rays). Scales 8-about 66-7; before dorsal, about 32. Gill-rakers long and slender, about 13+22.

Body elongate, compressed, slender; back not elevated; depth much less than head; head narrow, pointed; profile low, straight; maxillary reaching front of pupil; supplemental maxillary half greatest width of maxillary; mandible reaching posterior border of pupil; lower jaw slightly projecting when mouth is closed; a vertical protuberance at tip of lower jaw, and a slight notch at tip of upper jaw; apparently a few minute teeth on tongue. Caudal peduncle depth 1.63 in length from last anal to first caudal rays; its length 2.13 in head; dorsal insertion equidistant between tip of snout and first caudal ray; longest dorsal ray 1.61 in head; dorsal base 2.44 in head; adipose rather small, its length from tip to posterior end of base .5 vertical diameter of eye; caudal 1.2 in head; pectorals longer than dorsal, 1.5 in head, reaching a little more than halfway to ventrals; ventrals nearly equal to pectorals, 1.53 in head, reaching .6 distance to anal; longest anal ray 2.75 in head; anal base 2.36 in head. Lateral line straight, ascending a little at anterior end. Scales thin.

Color in spirits: pale; upper parts with fine dark punctulations, more numerous on back than on sides; dorsal and caudal slightly dusky; other fins plain.

Remarks.—The type and only specimen was taken from the stomach of a Lake Trout (*Cristivomer namaycush*).

***Leucichthys macrognathus*,² new species**

CISCO OF GREAT SLAVE LAKE

Type locality.—Shore waters of Great Slave Lake, near Fort Resolution, Mackenzie, Canada.

Type specimen.—No. 1031, Victoria Memorial Museum; specimen in alcohol (female with well-developed eggs); collected August 26, 1914, by Francis Harper.

¹Cf. Jordan and Evermann, 1911, Bull. U. S. Bureau Fisheries, XXIX, p. 4.

²From *μακρὸς* (long) + *γνάθος* (jaw).

Geographic range.—Known only from the type locality.

General characters.—Referable to the subgenus *Cisco* and closely allied to *L. athabasca*; differing from that form chiefly in deeper body, longer fins, and more numerous gill-rakers.

Description of type.—Total length, 247 mm.; length to base of caudal, 200 mm. Head (in latter measure) 4.17; depth 4.35; width 2 in depth. Eye (in head) 4.57; snout 3.69; maxillary 2.67; interorbital 4.8. Dorsal 11 (developed rays); anal 11 (developed rays). Scales 7—about 68—7; before dorsal, about 36. Branchiostegals 8. Gill-rakers 14+27.

Body elongate, compressed; back slightly elevated; the curve of dorsum and venter about equal; depth greatest in front of dorsal, nearly equal to head; head narrow, pointed; profile low, straight; maxillary reaching front of pupil; supplemental maxillary .67 greatest width of maxillary; mandible reaching posterior border of pupil; lower jaw distinctly projecting beyond snout when mouth is closed; a vertical protuberance at tip of lower jaw, and a slight notch at tip of upper jaw; a few minute teeth on tongue; gill-rakers long and slender, 1.33 in eye. Caudal peduncle depth 1.5 in length from last anal to first caudal rays, its length 2.29 in head; dorsal insertion equidistant between tip of snout and base of caudal; longest dorsal ray 1.26 in head; dorsal base 2.18 in head; adipose rather large, its height from tip to posterior end of base .8 vertical diameter of eye; caudal nearly as long as head; pectorals longer than dorsal, 1.14 in head, reaching nearly .75 distance to ventrals; ventrals nearly as long as dorsal, 1.33 in head, reaching .67 distance to anal; longest anal ray 1.85 in head; anal base 2.4 in head. Scales thin.

Color in spirits: pale; back faintly marked with dark punctulations; dorsal with fine dark punctulations, and caudal dusky toward tip; other fins plain.

Remarks.—The type and only specimen was taken in a small-meshed gill-net a few hundred yards offshore at Fort Resolution.

None of the three ciscoes here described belong to the "tullibee" group (subgenus *Allosomus*), though one or more of them are perhaps known locally by that name. *Leucichthys macrognathus*, with its prominent lower jaw and pointed, flattened head, approaches the coney (*Stenodus mackenzii*) in form, and bears a noteworthy superficial resemblance to that fish.



Fig. 1. *Catostomus richardsoni*, new species; type.



Fig. 2. *Coregonus preblei*, new species; type.

1

2

**Article III.—COLLEMBOLA FROM THE CROCKER LAND
EXPEDITION 1913-1917¹**

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PLATES XVI TO XXIII

The insects of the order Collembola that were collected in Greenland by M. C. Tanquary and W. E. Ekblaw, of the Crocker Land Expedition, and form the subject of this report, consist of the following eight species:

- | | |
|--|--|
| 1. <i>Achorutes tullbergi</i> Schäffer. | 5. <i>Isotoma diplophthalma</i> Axelson. |
| 2. <i>Achorutes armatus</i> (Nicolet). | 6. <i>Isotoma besselsi</i> Packard. |
| 3. <i>Onychiurus grælandicus</i> (Tullberg). | 7. <i>Isotoma olivacea</i> Tullberg. |
| 4. <i>Tetracanthella wahlgreni</i> Axelson-Linnaniemi. | 8. <i>Isotoma violacea</i> Tullberg. |

A ninth species, *Orchesella cincta* (Linnæus), var. *vaga* (Linnæus), from Newfoundland, though not collected by the Expedition, is also treated of.

Although none of these species are new, all of them except *Orchesella cincta* are here described and illustrated, for the reason that the existing descriptions of these species are scattered in many languages, and are often incomplete and insufficiently illustrated; while most of the literature of these forms is available only to specialists.

The Expedition brought back the little-known *Onychiurus grælandicus* and the interesting *Tetracanthella wahlgreni*, and added four species to the faunal list of Greenland.

It should be said that the descriptions and figures given here (with the exception of figure 38) have been made from the Greenland specimens.

The material upon which this report is based has been divided between The American Museum of Natural History, New York City, and the University of Illinois.

¹Scientific Results of the Crocker Land Expedition.

Achorutes tullbergi Schäffer

Plate XVI, Figures 1 to 8

Achorutes dubius TULLBERG, 1876. UZEL, 1890. SCHÖTT, 1894. DALLA TORRE, 1895. SCHÄFFER, 1896. SKORIKOW, 1900.

Achorutes dubius var. *concolor* CARPENTER, 1900.

Achorutes tullbergi SCHÄFFER, 1900a.

Achorutes tullbergi var. *concolor* SCHÄFFER, 1900a. WAHLGREN, 1907. FOLSOM, 1916.

Uniform blackish blue. Eyes eight on each side. Postantennal organs (Figs. 1, 2) with four (sometimes five) peripheral tubercles. Antennae shorter than the head; sense organ of third segment as in figure 3. Ungues (Fig. 4) stout, slightly curving; inner margin unidentate beyond the middle. Unguiculi with setaceous prolonged outer margin and with basal inner lamella, which is smallest on the front feet. Tenent hairs long; 2, 3, 3, as a rule; occasionally 3, 3, 3, or 1, 3, 3; when three hairs are present the middle hair is the stoutest. Mucrones (Figs. 5, 6) one-third dentate in length, with lamella narrow or of moderate width, somewhat variable in form, but more often apically rounded and upturned. Rami of tenaculum tridentate. Anal spines (Fig. 7) from two-fifths to two-thirds as long as hind ungues, arcuate, on prominent contiguous papillae. Clothing (Fig. 8) of sparse, short, curving, simple setae, with longer setae on the posterior part of the abdomen. Length, 2 mm.

The specimens collected by the Expedition belong to the variety *concolor* Carpenter, in which the dark blue pigment is distributed uniformly.

The typical form of the species is known from Nova Zembla, Spitzbergen, Siberia, and Bohemia; the variety *concolor* from Franz Josef Land, the vicinity of Ellesmere Land, and from Massachusetts.

Abundant (No. 45) Saunders Island, Greenland, June 15, 1914, crawling on ground on sunny slope. (M. C. Tanquary)

Achorutes armatus (Nicolet)

Plate XVII, Figures 9 to 13

Podura armata NICOLET, 1841.

Achorutes armatus GERVAIS, 1844. NICOLET, 1847. LUBBOCK, 1868, 1873. TULLBERG, 1871, 1872, 1876. PARONA, 1879, 1882, 1888, 1895. TÖMÖSVÁRY, 1883. OUDEMANS, 1890. UZEL, 1890, 1891. MACGILLIVRAY, 1891. SCHÖTT, 1891, 1894, 1896a, 1902. MONIEZ, 1894. DALLA TORRE, 1895. REUTER, 1895. MEINERT, 1896. SCHÄFFER, 1896, 1897, 1900a, 1900b. CARPENTER, 1897. LIE-PETTERSEN, 1896, 1898. POPPE AND SCHÄFFER, 1897. SCHERBAKOW, 1898b, 1899a. CARL, 1899, 1901. CARPENTER AND EVANS, 1899. WAHLGREN, 1900a. BÖRNER, 1901b. KRAUSBAUER, 1902. WILLEM, 1902. ÅGREN, 1903, 1904. AXELSON, 1905a, 1905b, 1906. LINNANIEMI (Axelson), 1907, 1909. COLLINGE AND SHOEBOOTHAM, 1910. IMMS, 1912. SHOEBOOTHAM, 1914. FOLSOM, 1916.

Achorutes boletivorus PACKARD, 1873. MACGILLIVRAY, 1891. DALLA TORRE, 1895. GUTHRIE, 1903.

Achorutes marmoratus PACKARD, 1873. MACGILLIVRAY, 1891. HARVEY, 1893.
Achorutes tezensis PACKARD, 1873. MACGILLIVRAY, 1891. DALLA TORRE, 1895.
Achorutes pratorum PACKARD, 1873. MACGILLIVRAY, 1891. DALLA TORRE, 1895.
Hypogastrura armata LINNANIEMI (Axelson), 1911, 1912. CAROLI, 1914.

Very variable in coloration. General color vinaceous, pale violet, greenish gray, or dark blue. The specimens in hand, from Greenland, are dark blue, pale ventrally. Eyes (Fig. 9) eight on each side. Postantennal organ (Fig. 9) large, with four unequal peripheral tubercles. Antennæ shorter than the head; segments in relative lengths as 5:4:5:6; fourth segment with seven olfactory hairs: two outer, two inner, and three dorsal. Between the third and fourth antennal segments is a large ventral eversible bilobed sac. Body stout; abdomen feebly dilated. Unguis (Fig. 10) long, slender, slightly curving, unidentate near the middle of the inner margin; lateral margins each unidentate one-fourth from the base. Unguiculus with basal lamella and setaceous apex, extending about as far as the tooth of the opposite claw. One long simple hair, in place of a tenent hair. Dentes stout, subcylindrical. Mucro (Fig. 11) half as long as dens, apically rounded; inner lamella narrow, simple; outer lamella with a large subtriangular dorsal lobe. Anal spines (Fig. 12) long, a little longer than the unguis in adult specimens, slender, curving, on large contiguous papillæ, which are one-third to one-half as long as the spines. Clothing (Fig. 13) dense, consisting of abundant short curving setæ and numerous long hairs and setæ, which are frequently serrate. Length, 1.5 mm.

Achorutes armatus, one of the most abundant and best known species of Collembola, occurs in large colonies in a great variety of situations: under the loose moist bark of logs, on damp soil under wood or dead leaves, underground among the roots of grasses or other plants, in moss, and on pools of fresh water. This species is the one commonly found on fungi, particularly agarics, though it occurs on *Boletus*, *Polyporus*, *Morchella*, and other genera as well.

Achorutes armatus is one of the most widely distributed species of Collembola: It is known from all parts of Europe, from Siberia, Spitzbergen, Greenland, northern Africa (Tripoli), Sumatra, Ceylon, New Zealand, Brazil, Paraguay, Uruguay, and Chile. Our present records (see Folsom, 1916) indicate that it occurs throughout the United States.

Five specimens (No. 119), Umanak, Greenland, July 22, 1914, in mushroom. (W. E. Ekblaw and M. C. Tanquary)

***Onychiurus grœnlandicus* (Tullberg)**

Plate XVII, Figure 14; Plate XVIII, Figures 15 to 23

Lipura grœnlandica TULLBERG, 1876. SCHÖTT, 1894. LUBBOCK, 1898. CARPENTER, 1900.

Lipura Schötti LIE-PETTERSEN, 1896.

Aphorura grœnlandica SCHÄFFER, 1900a.

White. Subcylindric; abdomen not dilated laterally (Fig. 14). Postantennal organs (Figs. 15-18) small, simple, each consisting of three or four simple peripheral tubercles, borne on a central stalk, and set in a small elliptical depression. Pseudocelli of head (Figs. 14 and 18) as follows: antennal base, 3+3, arranged in a triangle on each side; posterior border of head, 3+3; ventral surface of head, 1+1. Antennae shorter than the head; third and fourth segments stout, separated by an oblique suture. Sense organ of third antennal segment (Fig. 19) with five papillae, five guard setae, two tuberculate sense clubs in form as in figure 19, and a pair of sense rods. Pseudocelli of body (Fig. 14) as follows, in dorsal aspect: prothorax—pronotum, 1+1; proximal precoxal, 1+1. Mesothorax—mesonotum, 3+3; proximal precoxal, 1+1. Metathorax—metanotum, 3+3; proximal precoxal, 1+1. First to fourth abdominal segments, inclusive, 3+3. Fifth abdominal, 4+4; sixth, 0.

Unguis (Fig. 20) curving, untoothed. Unguiculus extending three-fifths as far as unguis; basal half with inner lamella; apical half acuminate. Anal spines (Figs. 21 and 22) two, a little longer than hind unguiculi, feebly curving, on widely separated papillae that are reduced to rings. Clothing (Fig. 23) of sparse short simple setae. Maximum length, 1.7 mm.

The tubercles of the postantennal organ are usually three, occasionally four, in number.

One specimen had three pseudocelli on the antennal base of the left side, but only two on the right side, the absent pseudocellus being the anterior inner one.

Though Tullberg (1876, p. 41) mentions but one tubercle for the postantennal organ, his figure shows two—one on each side of the central stalk. The same appearance is presented in my material under moderately high magnification; the remaining one or two tubercles being as a rule less evident, and appearing clearly only under much higher magnification.

Aphorura quadrituberculata Börner (1901a, p. 4) is probably this species. *Onychiurus affinis* Ågren (1903, p. 128), a detailed account of which is given by Linnaniemi (1912, p. 89) is closely related but apparently distinct.

The postantennal organs of *O. grænlandicus* and its few allies are simple in structure as compared with those of other species of *Onychiurus* and are, at least in external appearance, essentially like those of many species of *Achorutes*.

Onychiurus grænlandicus is a little-known Arctic species, which has been reported hitherto from Greenland, Spitzbergen, Franz Josef Land and Norway.

Nine specimens (No. 44), Saunders Island, Greenland, June 15, 1914, in moss. (M. C. Tanquary)

***Tetracanthella wahlgreni* Axelson-Linnaniemi**

Plate XIX, Figures 24 to 28

Tetracanthella pilosa SCHÖTT, 1891 (part), 1894 (part), 1902 (part). LIE-PETTERSEN, 1896. WAHLGREN, 1899, 1900b, 1906b. AXELSON, 1900.

Tetracanthella cœrulea SCHÄFFER, 1900a, 1900b.

Tetracanthella wahlgreni LINNANIEMI (Axelson), 1907, 1912. BAGNALL, 1914.

Dark blue. Body elongate, narrowing posteriorly. Eyes on black patches, 8+8 (Fig. 24); the two inner posterior eyes of each side smaller than the others; the five anterior eyes in a group apart from the three posterior. Postantennal organ (Fig. 24) narrowly elliptical, four times as long as the diameter of an adjacent eye, often with a constriction near the middle. Antennæ shorter than the head (as 16:13); segments in relative lengths about as 9:13:10:19 or 17:24:23:38. Sense organ of third antennal segment in an oblique groove, with a pair of oblique, basally bent sense rods, subtended by a thick chitinous ridge, and covered with an integumentary fold. Fourth antennal segment with curving slender olfactory setæ. Unguis (Fig. 25) stout, untoothed. Unguiculus extending half to three-fifths as far as unguis, lanceolate, acuminate. Clavate tenent hairs two, extending as far as, or farther than the unguis. Femur with a single long clavate hair. Second, third and fourth abdominal segments subequal in length dorsally. Anus ventral. Genital and anal segments confluent, bearing two pairs of spines (Fig. 26). Posterior spines a little longer than hind unguis, feebly curving, on stout papillæ almost half as long as the spines. Anterior spines similar to posterior spines, but a little shorter. Anogenital segment with many long stiff hairs, many of which extend backward beyond the end of the abdomen and are often apically bent and minutely clavate. Furcula quite short, appended to the fourth abdominal segment and extending to the posterior margin of the third abdominal segment. Manubrium stout, with several pairs of setæ. Mucro and dens confluent. Mucrodentes convergent, in form as in figure 27, each with three setæ. Rami of tenaculum bidentate; corpus with a single stout curved seta. General clothing (Fig. 28) of short equal curving simple setæ across the middle of the segment, with a transverse row of long erect simple sensory setæ. Cuticula not tuberculate, but figured. Length, 2 mm.

According to Linnaniemi (1912) the rami of the tenaculum are tridentate, sometimes bidentate; and the corpus bears at times two setæ.

The two specimens collected by the Crocker Land Expedition are small individuals, measuring 0.82 and 0.91 mm. in length, respectively. These agree in all essentials with the account of *T. wahlgreni* given by Linnaniemi (1912), who has separated this species from *T. pilosa* Schött.

The genus *Tetracanthella* is of special systematic importance as forming a link between Achorutinæ and Isotominæ.

This species, *wahlgreni*, has been taken usually under moss, lichens, or stones, and sometimes on the surfaces of pools. It is arctic or sub-arctic in distribution, and has already been reported from Spitzbergen,

Bear Island, Finland, Norway, and Sweden. I have recently studied three specimens from Bernard Harbour, N. W. T., that were brought back by the Canadian Arctic Expedition, 1913-1916.

Two specimens (No. 126), Umanak, Greenland, July 22, 1914, in moss. (W. E. Ekblaw)

***Isotoma (Folsomia) diplophthalma* Axelson**

Plate XX, Figures 29 to 34

Isotoma diplophthalma AXELSON, 1902.

Folsomia quadrioculata var. *diplophthalma* LINNANIEMI (Axelson), 1907, 1909.

COLLINGE AND SHOEBOOTHAM, 1910.

Isotoma binoculata COLLINGE AND SHOEBOOTHAM, 1909.

Folsomia diplophthalma LINNANIEMI (Axelson), 1911, 1912.

Elongate, white. Eyes (Fig. 29) 1+1, appearing as a round black spot on each side of the head. Postantennal organ (Fig. 29) close to eye, four to five times as long as the diameter of the eye, subelliptical, constricted near the middle of the anterior margin, with thick chitinous wall. Antennae slightly longer than the head, with segments in relative lengths about as 5:10:11:21 or 5:10:10:18. Unguis (Figs. 30 and 31) simple, without lateral or inner teeth. Unguiculus lanceolate, untoothed, extending half as far as the unguis on the fore feet (Fig. 30) and two-thirds as far on the hind feet (Fig. 31). Tenent hairs absent. Last three abdominal segments ankylosed, with sometimes a trace of a dorsal suture between the fourth and fifth abdominal segments. Anus ventro-caudal. Furcula appended to the fourth abdominal segment, short, extending not quite to the posterior margin of the second abdominal segment. Manubrium stout, longer than dens (manubrium: dens: mucro = 5:4:1). Dens (Fig. 32) stout, with a few minute dorsal crenulations near the middle, and a long erect dorsal proximal seta. Each dens bears a basal inner pair of strong chitinous hooks. Mucro (Figs. 32 and 33) three-fifths as long as hind unguis, bidentate; apical tooth hooked; anteapical tooth subequal to apical or slightly larger, suberect or feebly hooked. Rami of tenaculum quadridentate; corpus with a single stout curving ventral seta. General clothing (Fig. 34) of dense short stiff setae, absent on the anterior and posterior regions of most of the body segments. Sensory setae long, outstanding, simple. Length, 1.1 mm.

The examples from Greenland agree accurately with Axelson's description of the species, except in regard to the second antennal segment, which in these two specimens happens to be not longer than the third—an unimportant difference.

In this paper I have followed Linnaniemi (1912) in regarding *diplophthalma* Axelson as specifically distinct from *quadrioculata* Tullberg, although the two forms are almost exactly alike, except as regards the number of eyes. Linnaniemi (1912) observes that in *diplophthalma* the olfactory setae of the fourth antennal segment (as many as eight of

which may be present) are clearly differentiated; while in *quadrioculata* they are difficult to distinguish from ordinary setæ.

This species is found on the ground under wood or dead leaves, and in moss. It has been reported hitherto only from Russia, Finland, Norway, Sweden, and England; but I have taken it abundantly in Illinois under damp logs and dead leaves in swampy places.

Two specimens (No. 44), Saunders Island, Greenland, June 15, 1914, in moss. (M. C. Tanquary)

***Isotoma (Archisotoma) besselsi* Packard**

Plate XXI, Figures 35 to 43

Isotoma Besselsii PACKARD, 1877. MACGILLIVRAY, 1891, 1896.

Isotoma besselsi SCHÄFFER, 1900a. FOLSOM, 1901. AXELSON, 1905b. WAHLGREN, 1906c.

Isotoma besselsii DAVENPORT, 1903. BACON, 1912, 1914.

Isotoma spitzbergenensis LUBBOCK, 1898. CARPENTER AND EVANS, 1899. SKORIKOW, 1900.

Isotoma arctica SCHERBAKOW, 1899a, 1899b.

Isotoma janmayensis WAHLGREN, 1900a.

Proisotoma besselsi LINNANIEMI (Axelson), 1907, 1911. BAGNALL, 1909.

Archisotoma besselsi LINNANIEMI (Axelson), 1912.

Gray, bluish gray, blue, or blackish; in alcohol more or less greenish. Borders of body segments pale or white, giving the insect a banded appearance. Posterior region of head and sides of body with unpigmented spots. Body slender. Head broad, long and low-arched. Eye spots elongate. Eyes 8+8 (Fig. 35), the two inner proximal eyes on each side being much smaller than the others. Postantennal organs (Fig. 35) elongate, narrowly elliptical, one and one-half to four times as long as the diameter of an adjacent eye. Antennæ usually as long as, or slightly longer than, the head; in some specimens 1.7 times as long, however. Antennal segments in relative lengths about as 3:4:5:4 or 8:10:9:12; the last segment being, therefore, relatively short. Sense organ of third antennal segment consisting of two feebly curving rods subtended by a chitinous ridge. Fourth antennal segment with a few curving blunt sensory setæ. Femur and tibiotalpus each with a distal subsegment (Figs. 36-38) on all the legs. Hind femur with a distal outer thornlike process (Fig. 38). Unguis (Figs. 36 and 37) narrow, curving, without lateral teeth and without an inner tooth; often with a small inner tooth according to Linnaniemi (1912, p. 120). Unguiculus extending three-fourths as far as unguis, broadly sublanceolate, apically setaceous, untoothed, with outer lamella absent. Tenent hairs absent. Third and fourth abdominal segments subequal, or third a little shorter than fourth (as 7:8). Fifth and sixth abdominal segments almost or completely ankylosed; there being, however, in some specimens, particularly in small individuals, a faint, short, dorsal suture between the two segments. The last two abdominal segments project conspicuously beyond the base of the furcula, which arises (apparently) from both the fourth and the fifth abdominal segments. Furcula stout, of almost uniform thickness, extending

not quite to the ventral tube. Manubrium long, slender, with long coxal, or basal, segment; with small ventral setæ and many longer or shorter stiff dorsal setæ. Manubrium equal to dens plus mucro in length. Dentes stout, not tapering distally, rounded apically, not crenulate or tuberculate dorsally, with many short setæ dorsally and ventrally. Mucrones (Figs. 39-41) about as long as hind unguiculi, tridentate, with a large apical tooth and a pair of large dorso-lateral basal teeth. Apical tooth shaped like the end of a canoe; basal teeth subtriangular, subequal and opposite. Rami of tenaculum (Fig. 42) quadridentate; corpus with a large sub-conical anterior accessory lobe, and without setæ. General clothing of dense short setæ (Fig. 43), becoming longer on the posterior part of the abdomen. Long outstanding setæ occur also on all the body segments. Two exceptionally long, slender, naked hairs, known as bothriotricha, are present dorsally on the genital segment. All the setæ are simple. Length usually 1-1.5 mm.; maximum, 2.1 mm.

The postantennal organs vary considerably in length, but in the Greenland specimens are about three times as long as the diameter of an adjacent eye.

The antennal segments vary greatly in relative lengths, but the fourth is characteristically short in relation to the third.

In specimens from Massachusetts some of the stiff outstanding setæ of body, legs, and antennæ are thickened and spinelike, as in figure 38—a condition not found as yet in the Arctic material that I have studied.

Some years ago, through the courtesy of Dr. A. S. Packard, I examined eighteen cotypes of this species, the property of the United States National Museum. These were collected by Dr. Bessels at Polaris Bay, Greenland, Lat. 81° 20'-81° 50' N.

Isotoma besselsi is strictly a littoral species, being limited to the seashore between tide marks, where it occurs under stones, seaweed or driftwood, or burrowing in the sand, or exposed on the shore. It is an agile species and a vigorous jumper, as mentioned by Davenport (1903) in his interesting account of the distribution and movements of littoral Collembola.

Isotoma besselsi has been recorded from Greenland, Jan Mayen Land, Spitzbergen, Nova Zembla, Russia (Kola Peninsula), Finland, Norway, Scotland, England, Massachusetts, New York, California and Tierra del Fuego. The species is known to range from northern Greenland almost to the Antarctic Circle and, in my opinion (Folson, 1901), owes its exceptional distribution to marine currents.

Thousands of specimens (Nos. 68, 138), Umanak, Greenland, June 28, July 26, 1914, under stones along beach. (M. C. Tanquary)

Isotoma olivacea Tullberg

Plate XXII, Figures 44 to 52

Isotoma olivacea TULLBERG, 1871, 1872. UZEL, 1890. SCHÖTT, 1894, 1896b, 1902.

REUTER, 1895. LIE-PETTERSEN, 1896. SCHERBAKOW, 1898a, 1898b. WAHLGREN, 1900a, 1906a, 1906b. BÖRNER, 1901b. AXELSON, 1904, 1905b, 1906.

LINNANIEMI (Axelson), 1907, 1909, 1911, 1912.

Isotoma voraginum UZEL, 1890.

Olivaceous greenish, in alcoholic specimens, as the effect of a blue pigment with a yellowish ground color. Head and body with many pale spots of the ground color. Legs and furcula pale, or pigmented basally. Antennæ pigmented distally, paler proximally. Eyes (Fig. 44) 8+8, subequal. Postantennal organ (Fig. 44) elliptical, two and one-half to three times as long as the diameter of an adjacent eye. Antennæ longer than the head; third segment usually a little shorter than the second; occasionally equal to second or even slightly longer. Sense organ of third antennal segment as in figure 45, subtended by a chitinous ridge. Fourth antennal segment without olfactory setæ. Unguis (Fig. 46) curving, with a pair of small lateral teeth; inner margin unidentate near the middle, though the tooth is sometimes minute or absent, especially in small individuals. Unguiculus extending half as far as unguis, broadly sublancoolate, apically acuminate, with usually a minute angle-tooth. Tenent hairs absent; in place of these a single long seta. Abdominal segments without ankylosis. Third abdominal segment slightly longer than the fourth (as 12:11); occasionally equal to fourth. Furcula appended to the fifth abdominal segment and extending to the ventral tube. Dentes more than twice as long as manubrium (as 44:19), slender, gradually tapering, dorsally crenulate, the crenulations disappearing a little in advance of the mucro. Mucro three-fourths as long as hind unguiculus, quadridentate (Figs. 47-50). Apical tooth the longest, hooked. Anteapical tooth a little shorter, conical, erect or slightly inclined. Third and fourth teeth subequal, almost opposite, oblique or suberect, one being lateral and the other mesal in position. Rami of tenaculum (Fig. 51) quadridentate; corpus with several setæ (five to eight seen in various specimens). Clothing (Fig. 52) of dense stiff simple setæ, becoming longer posteriorly; with a transverse row of longer suberect simple setæ across the middle of most of the body segments. Length, 1.5 mm. (2 mm. in large European specimens).

The antennal segments vary greatly in relative lengths, which may be expressed approximately, however, as 8:11:10:17 or 7:16:13:21; occasionally there occurs such a formula as 4:7:7:12.

The specimens from Greenland agree with my European examples of *olivacea*, which were determined by Schött and sent to me by Schäffer. This is evidently the *forma principalis* of Linnaniemi (1912, p. 149).

In Europe, this species is found on the ground under stones, wood, or dead leaves, on pools and often in moss. It is known from Norway, Sweden, Russia, Germany, and Bohemia. Although *olivacea* is one of the most abundant collembolans in parts of northern Europe (Finland, for

example), it has been reported but once from the Polar region, when Wahlgren (1900a, p. 367) recorded a single individual taken under moss near the seashore in East Greenland (Lat. 72° 46' N.).

Fourteen specimens (No. 126), Umanak, Greenland, July 22, 1914, in moss. (W. E. Ekblaw)

Isotoma violacea Tullberg

Plate XXIII, Figures 53 to 60

Isotoma violacea TULLBERG, 1876. SCHÖTT, 1894, 1902. REUTER, 1895. LIL-PETTERSEN, 1896. SCHÄFFER, 1896, 1900a, 1900b. POPPE AND SCHÄFFER, 1897. SCHERBAKOW, 1898b. SKORIKOW, 1900. BÖRNER, 1901b. ÅGREN, 1903, 1904. AXELSON, 1904, 1905b, 1906. LINNANIEMI (Axelson), 1909, 1911, 1912. WAHLGREN, 1906a, 1906b. SHOEBOOTHAM, 1911.

Isotoma violacea var. *mucronata* AXELSON, 1900. LINNANIEMI (Axelson), 1912. WAHLGREN, 1906b.

Isotoma mucronata AXELSON, 1904, 1905b, 1906. LINNANIEMI (Axelson), 1907, 1909, 1911. ÅGREN, 1904.

Clear violet or blackish violet. Legs and furcula white, or pigmented basally; antennæ violet. Body with many pale spots. Anterior borders of body segments pale, giving the effect of narrow bands; head frequently pale laterally. Postantennal organ (Fig. 53) situated close to the eyes, elliptical, slightly longer than the diameter of an adjacent eye (as 7:6 or 10:9), with a wide border. Eyes (Fig. 53) 8+8, subequal. Antennæ longer than the head, with segments in relative lengths about as 11:15:18:30 or 9:14:15:29. Sense organ of third antennal segment as in figure 54, with a chitinous ridge. Fourth antennal segment without olfactory setæ. Unguis (Fig. 55) curving, with a pair of lateral teeth, and without an inner tooth (present, however, in some European specimens). Unguiculus extending a little more than half as far as the unguis, broadly sub lanceolate, acuminate, with an inner tooth, usually evident but occasionally obscure. Tenent hairs absent. Abdominal segments without ankylosis. Third and fourth abdominal segments subequal, or third slightly shorter than the fourth (as 6:7). Furcula appended to the fifth abdominal segment, extending to the ventral tube. Dens two and one-half times as long as manubrium, slender, gradually tapering, crenulate dorsally, the crenulations becoming gradually smaller distally and disappearing some distance in advance of the mucro. Mucro slightly shorter than hind unguiculus, quadridentate (Figs. 56-58). Apical tooth usually the longest. Anteapical tooth suberect, occasionally as large as the apical tooth. Third and fourth teeth proximal, almost opposite; one being lateral in position. A subapical ventral bristle on the dens extends beyond the middle of the mucro in some specimens; in others it is short. Rami of tenaculum quadridentate (Fig. 59); corpus with a few stout ventral setæ (as many as 16 in large European examples). General clothing (Fig. 60) of numerous strong, stiff or curving setæ, moderately long; with long stout outstanding setæ, numerous and bowed on the last two abdominal segments. These large setæ are simple in typical *violacea*, but feathered in the variety *mucronata*. Length, 1.3 mm. (maximum, 3.1 mm. in European specimens).

The inner tooth of the unguis is said by some European writers to be present, and by others to be absent; it doubtless varies in its occurrence, as it does in many other species of *Isotoma*.

Thirteen of the specimens collected by Mr. Ekblaw have the pinnate setæ that distinguish the variety *mucronata*; the remaining specimen, without feathered setæ, is typical *violacea*.

In Europe, *Isotoma violacea* is a common species under loose bark, stones, or dead leaves, and in moss. The typical form is known from Norway, Sweden, Russia, Finland, Siberia, Germany, Switzerland, England, and Spitzbergen; the variety *mucronata* from Norway, Sweden, and Finland.

Fourteen specimens (Nos. 122, 126), Umanak, Greenland, July 22, 1914, in moss. (W. E. Ekblaw)

***Orchesella cincta* (Linnæus) var. *vaga* (Linnæus)**

Podura vaga LINNÆUS, 1767.

Heterotoma vaga BOURLET, 1839. GÉRAIS, 1844.

Orchesella cincta var. *vaga* REUTER, 1895. SCHÄFFER, 1896, 1900b. SCHERBAKOW, 1898b. CARL, 1899, 1901. CARPENTER AND EVANS, 1899. BÖRNER, 1901b. KRAUSBAUER, 1901. VOIGTS, 1902. ÅGREN, 1903. AXELSON, 1905b, 1906. LINNANIEMI (Axelson), 1907, 1912. WAHLGREN, 1906b. LIE-PETERSEN, 1907. COLLINGE AND SHOEBOOTHAM, 1910.

Among the material received for study from The American Museum of Natural History was one specimen from Newfoundland which, though not collected by the Crocker Land Expedition, may appropriately be recorded here.

This specimen, mounted on a card point, was shrunk and somewhat mutilated, but still recognizable as the black variety *vaga* of the common *Orchesella cincta*.

Head and body black with these exceptions: second abdominal segment white; mesonotum and metanotum each with a lateral elongate oblique white mark. First and third antennal segments black; second segment black on proximal half, white on distal half. Femora black; tibiotarsi white, or slightly pigmented apically. Furcula white. Length, 3.4 mm.

Orchesella cincta, which is found on the ground under dead leaves, wood or stones, as well as in moss and under loose bark, is a conspicuous collembolan on account of its size, coloration, activity, and abundance. The species is highly variable in coloration, but nevertheless easily distinguishable.

Throughout Europe, *Orchesella cincta* is a common species, and in all parts of Europe its dark variety *vaga* occurs, being in Switzerland (Carl, 1899) much more numerous than the typical form of the species. Notwithstanding the abundance of the species in Europe, the only evidence of its presence in the Arctic region is one record of its occurrence in northwestern Siberia (Reuter, 1891). A single individual was taken in Newfoundland in 1871 (Tullberg, 1876).

In this country, the species is common in eastern Massachusetts, and has been recorded by Packard (1873) from New York, Tennessee, and Texas.

One specimen (F3122), Bay of Islands, Newfoundland, July 21-24, 1912. (C. W. Leng)

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PLATE XVI

- Fig. 1. *Achorutes tullbergi*, left postantennal organ, with adjacent eyes, $\times 7$
Fig. 2. *Achorutes tullbergi*, left postantennal organ, $\times 1260$.
Fig. 3. *Achorutes tullbergi*, sense organ of third antennal segment of left side
 $\times 735$.
Fig. 4. *Achorutes tullbergi*, right hind foot, $\times 592$.
Fig. 5. *Achorutes tullbergi*, right mucro, $\times 735$.
Fig. 6. *Achorutes tullbergi*, left mucro, $\times 735$.
Fig. 7. *Achorutes tullbergi*, left anal spine, $\times 735$.
Fig. 8. *Achorutes tullbergi*, dorsal setæ of first abdominal segment, $\times 390$.

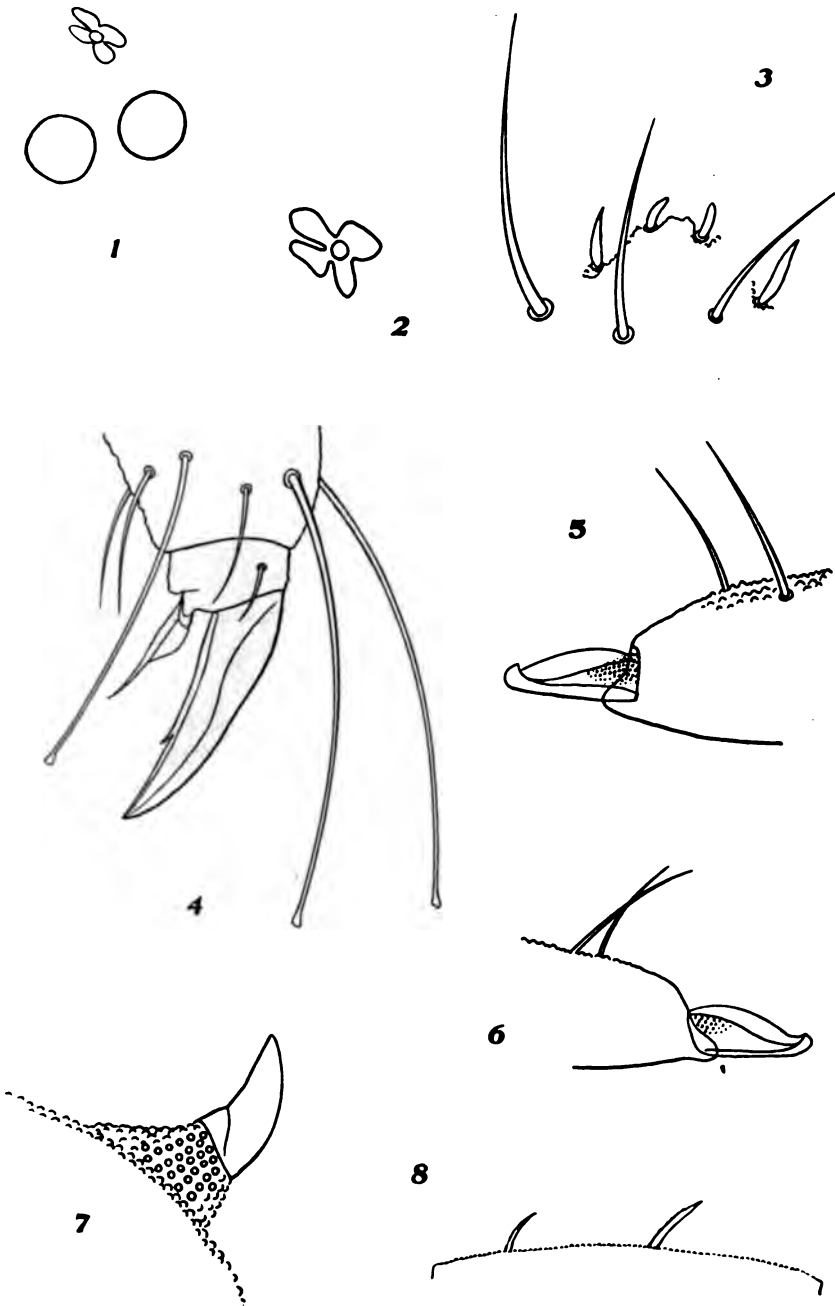
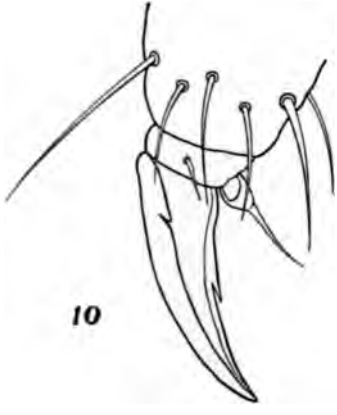
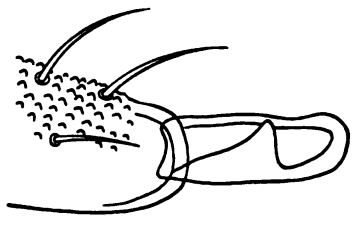


PLATE XVII

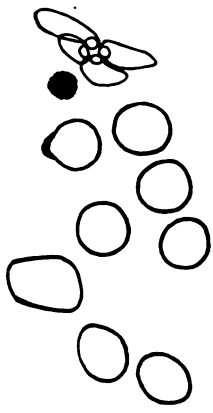
- Fig. 9. *Achorutes armatus*, eyes and postantennal organ of left side, $\times 757$.
Fig. 10. *Achorutes armatus*, left fore foot, $\times 757$.
Fig. 11. *Achorutes armatus*, left mucro, $\times 757$.
Fig. 12. *Achorutes armatus*, right anal spine, $\times 450$.
Fig. 13. *Achorutes armatus*, dorsal setæ of first abdominal segment, $\times 757$.
Fig. 14. *Onychiurus grænlandicus*, dorsal aspect to show pseudocelli, $\times 76$.



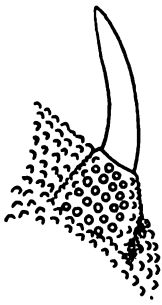
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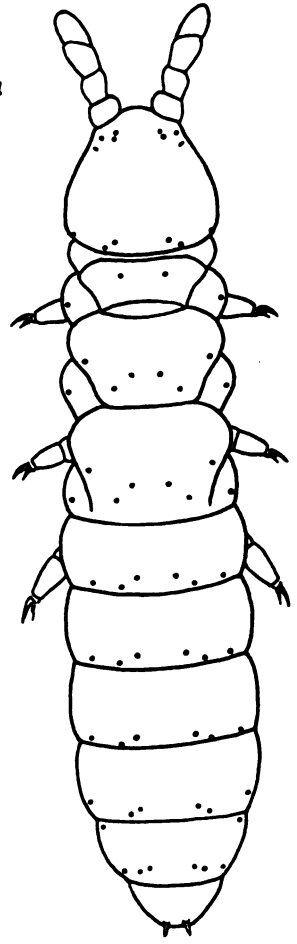
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PLATE XVIII

- Fig. 15. *Onychiurus grænlandicus*, right postantennal organ, $\times 800$.
Fig. 16. *Onychiurus grænlandicus*, right postantennal organ, $\times 800$.
Fig. 17. *Onychiurus grænlandicus*, left postantennal organ, $\times 800$.
Fig. 18. *Onychiurus grænlandicus*, pseudocelli of left antennal base, with postantennal organ, $\times 365$.
Fig. 19. *Onychiurus grænlandicus*, sense organ of third antennal segment, right side, $\times 1260$.
Fig. 20. *Onychiurus grænlandicus*, left hind foot, $\times 505$.
Fig. 21. *Onychiurus grænlandicus*, anal spines, $\times 295$.
Fig. 22. *Onychiurus grænlandicus*, right anal spine, $\times 505$.
Fig. 23. *Onychiurus grænlandicus*, dorsal setæ of first abdominal segment, $\times 260$.



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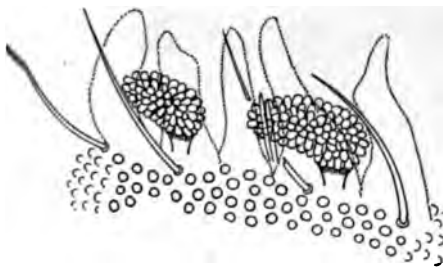


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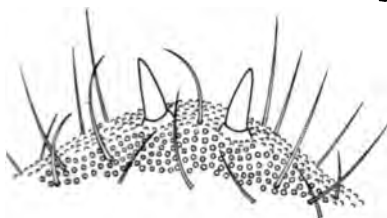
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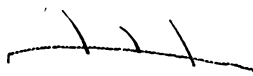


PLATE XIX

- Fig. 24. *Tetracanthella wahlgreni*, eyes and postantennal organ of right side, $\times 757$.
Fig. 25. *Tetracanthella wahlgreni*, right hind foot, $\times 1192$.
Fig. 26. *Tetracanthella wahlgreni*, abdominal spines, $\times 337$.
Fig. 27. *Tetracanthella wahlgreni*, left aspect of mucrodentes, $\times 757$.
Fig. 28. *Tetracanthella wahlgreni*, dorsal setæ of third abdominal segment, $\times 450$.

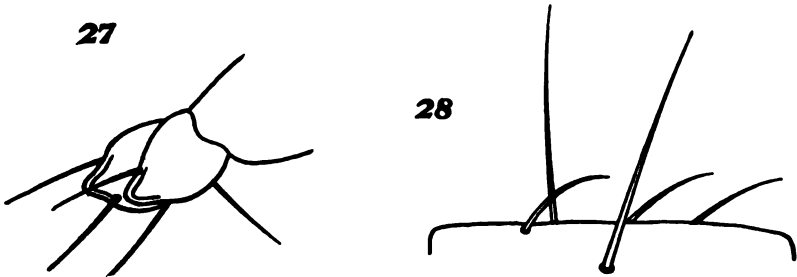
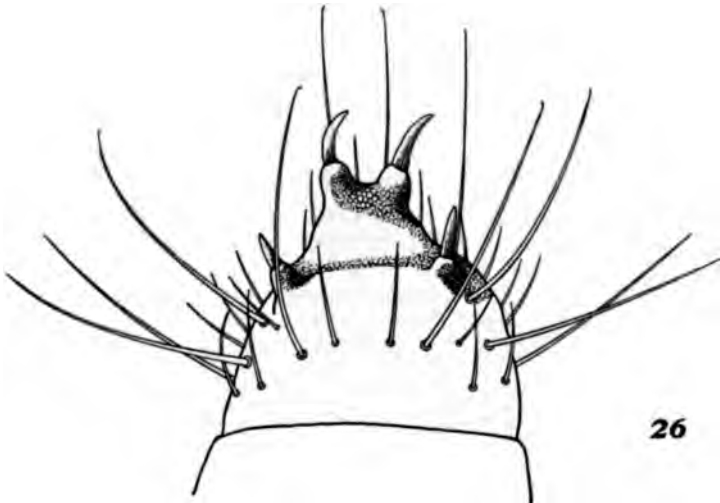
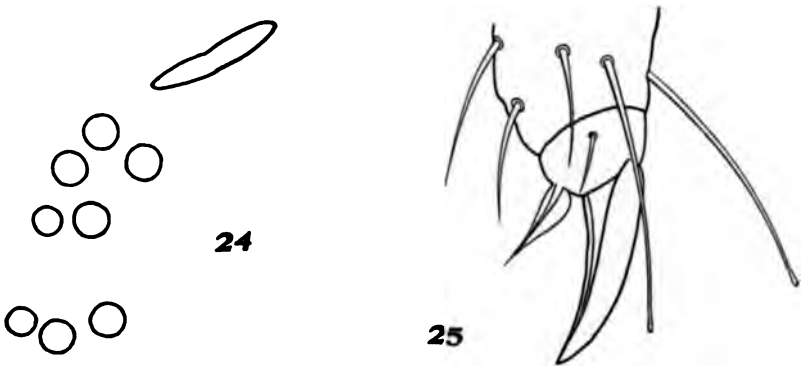


PLATE XX

- Fig. 29. *Isotoma diplophthalma*, eye and postantennal organ of right
×882.
- Fig. 30. *Isotoma diplophthalma*, right fore foot, ×1143.
- Fig. 31. *Isotoma diplophthalma*, left hind foot, ×1143.
- Fig. 32. *Isotoma diplophthalma*, right dens and mucro, with basal teeth
through the dens, ×684.
- Fig. 33. *Isotoma diplophthalma*, left mucro, ×1231.
- Fig. 34. *Isotoma diplophthalma*, dorsal setæ of first abdominal segment

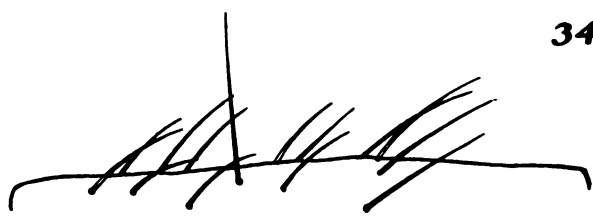
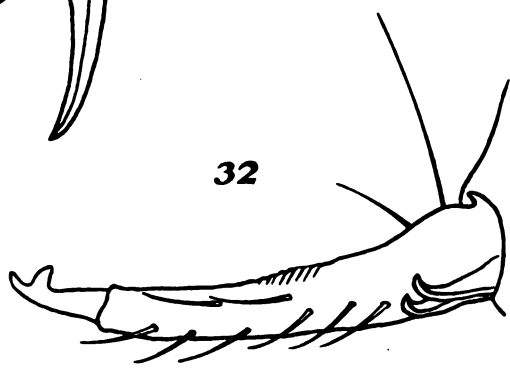
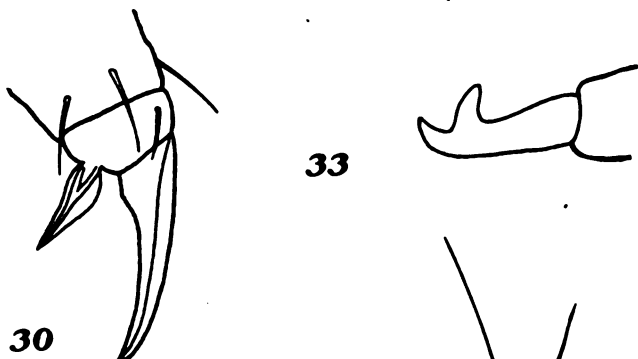
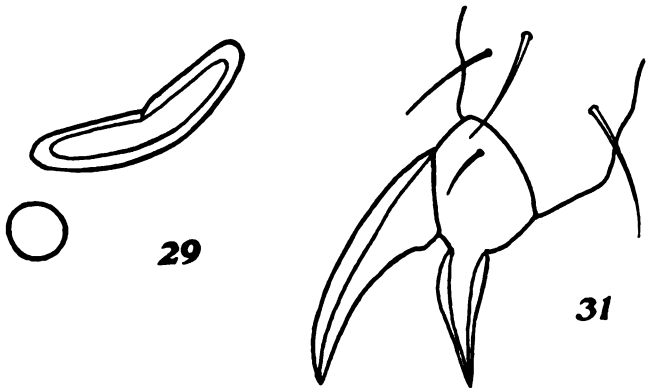


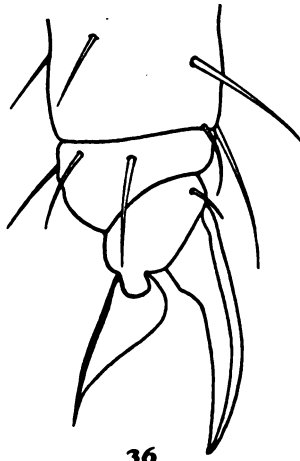
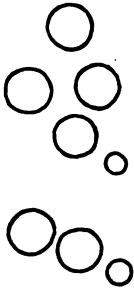
PLATE XXI

- Fig. 35.** *Isotoma besselsi*, eyes and postantennal organ of left side, $\times 480$.
Fig. 36. *Isotoma besselsi*, left hind foot, $\times 673$.
Fig. 37. *Isotoma besselsi*, left hind foot, $\times 793$.
Fig. 38. *Isotoma besselsi*, portion of left hind femur and tibiotarsus (from
Massachusetts specimen), $\times 673$.
Fig. 39. *Isotoma besselsi*, left mucro, $\times 1045$.
Fig. 40. *Isotoma besselsi*, left mucro, $\times 793$.
Fig. 41. *Isotoma besselsi*, right mucro, $\times 653$.
Fig. 42. *Isotoma besselsi*, left aspect of tenaculum, $\times 793$.
Fig. 43. *Isotoma besselsi*, dorsal setæ of first abdominal segment, $\times 480$.

A. M. N. H.



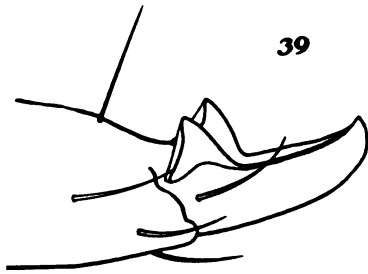
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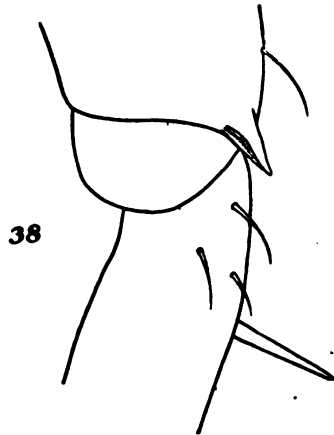
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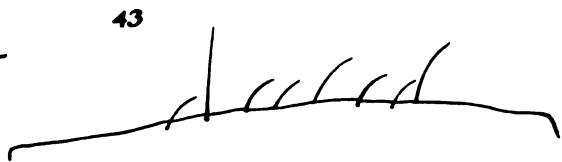
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PLATE XXII

- Fig. 44. *Isotoma olivacea*, eyes and postantennal organ of left side, $\times 384$.
Fig. 45. *Isotoma olivacea*, sense organ of third antennal segment of right side,
 $\times 1270$.
Fig. 46. *Isotoma olivacea*, right hind foot, $\times 1016$.
Fig. 47. *Isotoma olivacea*, left mucro, $\times 1272$.
Fig. 48. *Isotoma olivacea*, left mucro, $\times 1272$.
Fig. 49. *Isotoma olivacea*, right mucro, $\times 1333$.
Fig. 50. *Isotoma olivacea*, left mucro, $\times 1272$.
Fig. 51. *Isotoma olivacea*, left aspect of tenaculum, $\times 784$.
Fig. 52. *Isotoma olivacea*, dorsal setæ of second abdominal segment. $\times 472$.

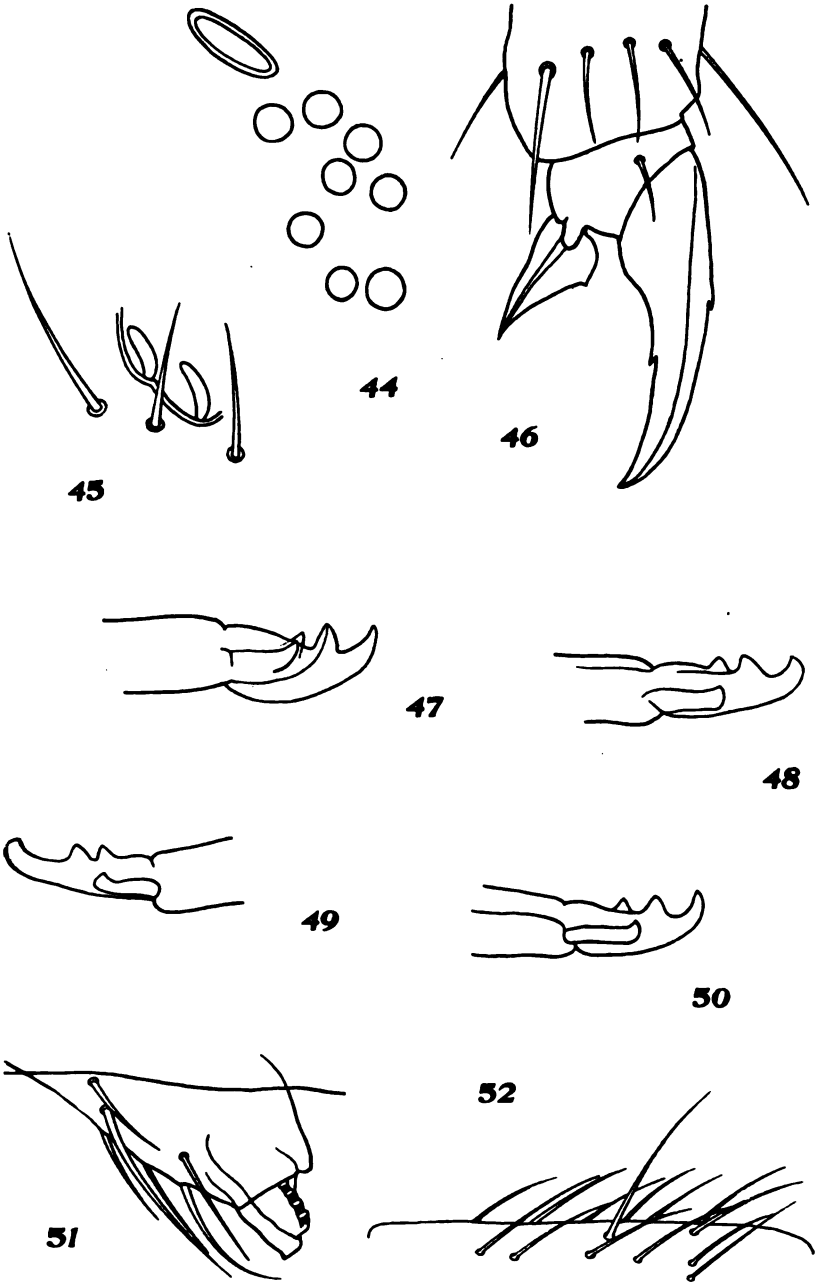
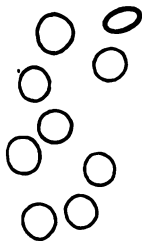
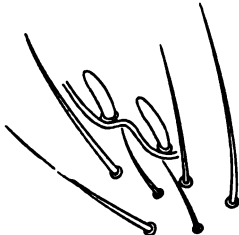


PLATE XXIII

- Fig. 53. *Isotoma violacea*, eyes and postantennal organ of right side, $\times 442$.
Fig. 54. *Isotoma violacea*, sense organ of third antennal segment of right side,
 $\times 952$.
Fig. 55. *Isotoma violacea*, left hind foot, $\times 1192$.
Fig. 56. *Isotoma violacea*, left mucro, $\times 1908$.
Fig. 57. *Isotoma violacea*, right mucro, $\times 1908$.
Fig. 58. *Isotoma violacea*, left mucro, abnormal in having but three teeth, $\times 1908$.
Fig. 59. *Isotoma violacea*, left aspect of tenaculum, $\times 757$.
Fig. 60. *Isotoma violacea*, dorsal setæ of second abdominal segment, $\times 735$.



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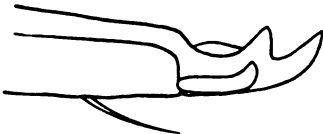
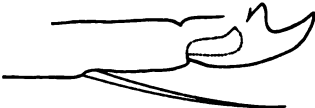


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Article IV.—INSECTS OF FLORIDA

Va. SUPPLEMENTARY NOTES ON THE WATER BEETLES

BY W. S. BLATCHLEY

In the fifth paper¹ of a series on the Insects of Florida, Chas. W. Leng and Andrew J. Mutchler give¹ a list of all the species of the families Dytiscidæ, Haliplidæ, Gyrinidæ, Hydrophilidæ, Sphæridiidæ, and Parniæ, known to the authors to occur in Florida, with full notes on their distribution within that state and keys to the species of many of the genera. They refer to the writer quite often as furnishing notes on distribution and also descriptions of several species. The data for most of these notes were obtained and given to Mr. Leng some years ago. More extended collecting in the southern part of the state and more careful study of the species taken have furnished additional facts concerning the distribution of many of the species listed, and have also led to a change of opinion regarding the names of some of the species. The following notes, additions, and corrections are therefore offered as supplementary to the valuable paper of Leng and Mutchler, the species added being *Copelatus debilis* Sharp, *Copelatus chevrolati australis* Schaeffer, *Agabus semivittatus* LeConte, *Derallus altus* (LeConte) and the new species herein described, while *Dineutes emarginatus* (Say) should be stricken from their list.

The collecting by the writer in Florida has been limited to the period between October 20 and April 15 and has extended over a range of seven years.² While the majority of Florida beetles which pass the winter in the adult stage are, at that season, inactive and more or less in a state of hibernation, this is not true of the water beetles and they can be taken in numbers at any time. A cold snap lasting several days, or even weeks, doubtless causes many of them to burrow in the mud or hide beneath débris along the shores. A few warm days will, however, make them as active and abundant as before and during February and March they often swarm in numbers in suitable pools and ditches.

Leng and Mutchler state that the water beetles of Florida were seldom found in its beautiful clear lakes, but rather in road-side ditches, shallow rain-pools, etc., in which there was some vegetable growth. Now, the beetles are in the lakes and can be collected in numbers along

¹1918, Bull. American Mus. of Nat. Hist., XXXVIII, pp. 73-116.

²Several species have been taken at porch lights during the summer months and sent to me.

their mucky margins, but most of the collecting has been done in the more easily explored ditches and ponds. A few weeks' work with a suitable dredge net in the deeper waters of the lakes would perhaps bring to light a number of additional species which frequent only the greater depths. The great majority, however, find their food, and therefore have their habitat, in the shallow waters along the shores.

Most of the writer's collecting of the water beetles of Florida has been done along the margins of ditches, ponds, and lakes in the vicinity of Dunedin, a town on the west coast twenty-one miles north of St. Petersburg and twenty-seven miles northwest of Tampa. One winter, however, was spent at Sarasota, seventy miles farther south, and two extended trips have been made to the Lake Okeechobee region. Collecting has also been done at Ormond, Gainesville, Sanford, Kissimmee, Lake Istokpoga, Miakka, Lakeland, La Belle, Fort Myers, Little River, Cape Sable, and Key West.

DYTISCIDÆ

Notomicrus nanulus (LeConte).—This minute species has been taken by the writer only along the margins of two woodland ponds near Dunedin, and then only in the winters of 1913 and 1917. It occurs on the under surface of boards wholly immersed in the water and, as far as remembered, has never been taken with the water net. It is so small and so nearly the color of its cover that, when the latter is removed, the beetle can be seen only when it moves. Not over fifteen specimens altogether have been found, though dozens of trips have been made to the ponds especially for it.

Colpius inflatus LeConte.—This is usually a scarce species about Dunedin, only two or three being found each season. However, in March 1919, more than 75 were taken from the margins of a lake one mile east of the town. At La Belle a dozen or more were obtained from a shallow woodland pond on February 26, 1918.

Hydrocanthus iricolor Say.—I have not taken the true *iricolor* Say of the northern states in Florida. My records of "Dunedin, Kissimmee, etc.," quoted by Leng and Mutchler, should refer to *H. oblongus* Sharp, which I had not differentiated at the time the notes were given to Mr. Leng. *H. iricolor*, as found in Indiana, is larger than *oblongus*, always iridescent reddish brown, and usually with two or three confused rows of small, vague dorsal punctures. I have, however,

in my cabinet six specimens labelled *Hydrocanthus iricolor* var., which agree with *iricolor* in size and punctuation, but have the upper surface, except the front margin of head, shining black. Four of them are labelled Lake Okeechobee, March 7; the others, Sanford, January 16, and Dunedin, January 2. They probably represent the *atricolor* which Leng and Mutchler, page 77, state I record from Sanford and Lake Okeechobee, though I can find no such record in my published papers. These black specimens are probably the same as the *H. texanus* Sharp of Leng and Mutchler.

***Hydrocanthus oblongus* Sharp.**—As separated by Leng and Mutchler, this is one of the most common water beetles of Florida, and has been taken by me at all points where collections have been made except Ormond and Fort Myers. It is very close to *iricolor* and will probably prove to be only a southern race of that species. The width of the prosternal process behind the front coxæ is variable and the hind coxal plates are as coarsely and closely punctate in northern *iricolor* as in *oblongus*. Both Crotch¹ and Horn² regarded all three forms viz., *iricolor*, *texanus*, and *oblongus* as one species.

***Canthydrus puncticollis* (Crotch).**—Single specimens of this well-marked form have been taken at Lake Okeechobee, March 6, and Dunedin, January 12. The *C. gibbulus* Aubé of my "Coleoptera of Indiana" is this species. Leng and Mutchler have, unfortunately, used my description of *C. gibbulus*, which should apply to *puncticollis*, under the former name. The descriptions which they give of both *puncticollis* and *gibbulus* are, therefore, essentially the same and both apply to *puncticollis*.

***Canthydrus floridanus* Blatchley.**—Only one specimen of this short, convex species has been taken since it was described. It was found on the under side of an immersed board in a pond near Dunedin.

***Canthydrus bicolor* (Say).**—I have not yet taken this species in Florida. Indiana specimens show that the color is the same as that of *gibbulus*, but the form is broader and the elytra are more coarsely punctate.

***Canthydrus gibbulus* (Aubé).**—I have found this one of the two most common dytiscids in Florida, the other being *Laccophilus proximus* Say. Both have been taken in numbers at every point where collections have

¹1873, Trans. American Ent. Soc., IV, p. 396.

²1883, Idem, X, p. 277.

been made. *C. gibbulus* is very close to *bicolor*. Sharp¹ states that "*bicolor* scarcely differs from *gibbulus* except in sexual characters (given in the accompanying key), and that it generally has the elytra and under surface darker in color." Henshaw, following Sharp, listed the two as distinct. I can find no differences except those given in the key below, which are comparative only.

The four species of *Canthydrus* above mentioned may be separated by the following key:

Key to Florida Species of *Canthydrus*

1. Elytra piceous black, each with an irregular oblique yellowish cross-bar just behind the middle; length 3 mm. *puncticollis*.
 Elytra uniform dark brown or piceous, without yellow bar. 2.
2. Thorax yellow, with a fuscous blotch on middle of front margin, its disk almost impunctate; form short, ovate, strongly convex; length 2-2.2 mm. *floridanus*.
- Thorax without fuscous blotch; form more elongate, less convex; length 2.5-2.8 mm. 3.
3. Form broadly oval; elytra rather coarsely and deeply punctate; apical ventral segment rather deeply impressed each side in female only. *bicolor*.
 Form narrowly oval; elytra more finely and shallowly punctate; apical ventral segment transversely impressed at middle in both sexes. *gibbulus*.

Laccophilus gentilis Leconte.—This species has been taken by me at Sarasota, La Belle, and Dunedin. It is far less common than *proximus* and is sometimes found beneath boards in moist places some distance from water.

Hydrovatus compressus Sharp.—Specimens are at hand from Sarasota, Lake Okeechobee, La Belle, Lakeland, and Dunedin, January to March. It occurs more often along the margins of lakes than in the smaller ponds.

Desmopachria granum (LeConte).—This minute, subrotund species is quite widely distributed throughout southern Florida, having been taken in small numbers at Dunedin, Sarasota, Lakeland, La Belle, and Moore Haven. It is more often found on immersed boards than taken in the net.

¹1880-1882. Scientific Trans. Royal Dublin Soc., (2) XI, p. 271.

***Desmopachria mutchleri*, new species**

Form short rounded-oval, subdepressed above, strongly convex beneath. Head, apical three-fourths of thorax, legs, mouth parts, antennæ and under surface pale reddish brown; basal fourth of thorax with a transverse fuscous blotch. Elytra reddish yellow with a large common W-shaped piceous mark; the entire suture, forming the center of the W, broadly piceous, the apical margin narrowly so. Clypeus broadly rounded, distinctly margined. Eyes large, separated by their own width. Head and thorax very finely, sparsely and unevenly punctate. Elytra a little more coarsely, rather closely and more evenly punctate. Meso- and metasterna finely and sparsely punctate; abdomen with a few very minute scattered punctures. Length, 2-2.3 mm.

Four specimens taken in a deep pool on the site of an old, abandoned sawmill two miles northeast of Dunedin, March 22, 24, 1919. The pool was not over ten feet square and was over the abandoned surface-well which formerly supplied the mill with water. A shallow pond covering about ten acres was within thirty feet of the pool. With the *Desmopachria*, half a dozen specimens each of *Haliphus annulatus* Roberts and *Thermonecles ornatcollis* (Aubé), neither of which had before been known to occur within fifty miles of Dunedin, were taken from the pool. Type and allotype in my collection; one of the paratypes in The American Museum of Natural History collection and another in the private collection of H. C. Fall.

Named in honor of Andrew J. Mutchler, the able assistant entomologist of The American Museum of Natural History, who has kindly given me much aid in the preparation of this and previous papers on Florida Coleoptera.

Of the eight valid species of the genus *Bidessus* listed by Leng and Mutchler, I have taken but five in Florida but have two additional forms from there which seem not to have been described. All my specimens have been carefully compared with the original descriptions or with the Indiana species which, at the time I wrote of them, were passed upon by the late Frederick Blanchard, who had made a special study of the group. Those at hand from Florida are as follows.

***Bidessus fuscatus* (Crotch).**—I have not taken this species in Florida. Mr. Mutchler kindly sent me two specimens from Taylor Co., Florida, one of which was labelled *B. fuscatus* Cr., the other *B. lacustris* Say, stating that they had been so named by the late Mr. Roberts. Both represent the same species and are probably *fuscatus*. Since both specimens are from exactly the same locality, it is possible that there was some confusion in the original placement. They differ

from *Indiana fuscatus* only in the paler color, the species being distinguished by the very short, almost obsolete basal striae and coarse punctures of the elytra.

***Bidessus exiguus* (Aubé).**—This easily distinguished little species is the most common *Bidessus* about Dunedin and has also been taken at La Belle and Lakeland. It occurs in numbers along the grassy margins of small lakes and ponds.

***Bidessus pulicarius* (Aubé).**—In addition to the stations attributed to me by Leng and Mutchler, page 81, I can add only Lakeland and La Belle; February 22 to 28.

***Bidessus longovalis*, new species**

Elongate-oval, feebly convex at middle. Pale brownish yellow; elytra dark reddish brown to piceous, moderately shining, very sparsely clothed with exceedingly fine grayish yellow hairs. Head and front half of thorax minutely and very sparsely punctate. Thorax more than twice as wide as long, distinctly and closely punctate in front of the sinuate basal margin, which is fuscous between the basal striae, the latter short, very fine. Elytra not wider at base than thorax and nearly four times as long, sides feebly and broadly curved to the rather blunt apex; basal striae deep, twice as long as those of thorax; disk rather coarsely and densely punctate. Under surface finely and remotely punctate. Length, 2.1–2.3 mm.

This species has been taken in small numbers only at Dunedin, La Belle, and Kissimmee; January to March. When first taken I considered it *B. pulicarius* (Aubé) but, after comparing it more closely with undoubted *Indiana* specimens of that name, I noted important differences, and sent a specimen to Mr. Fall for examination under the identification Number 83. On March 16, 1917, he wrote me as follows: "No. 83. I succeeded in losing this in the process of relaxing and mounting. However, I had one or two examples of the same thing previously sent by you. I have recently described this in Ms. as *floridanus*. My type is from Jacksonville, the description having been written before I learned that the species sent by you was the same thing." This report by Fall led me to record this species as *B. floridanus* Fall¹ and to make the wrong statement that that species "bears a close general resemblance to *B. pulicarius* Aubé." I also sent out specimens under the name of *B. floridanus* and Mr. Mutchler, judging that they were correctly named, described the true *floridanus* as *B. shermani*. Had Mr. Fall succeeded in mounting the specimen sent him and then compare

¹1918, Canadian Ent., L, p. 52.

it closely with those previously sent, he would undoubtedly have noted the differences and the unfortunate mix-up would have been avoided.

B. pulicarius differs from *B. longovalis* in its shorter, more broadly oval form which is much more convex at middle; in the paler hue of elytra and in having the pubescence much coarser, more abundant, distinctly yellow; punctation of elytra finer and basal elytral striæ distinctly shorter, being only one-half longer than those of thorax.

***Bidessus affinis* (Say).**—Taken by me only at Dunedin, where it is scarce. My records of Arch Creek and Bassenger, given to Mr. Leng, apply to *B. floridanus* Fall, which I formerly confused with *affinis*.

***Bidessus subsericeus*, new species**

Short-oval, obtuse at both ends, very feebly convex. Dull yellow; elytra piceous-brown with a purplish tinge, often with a vague pale oblong spot at apical third of side margin; pubescence exceedingly fine, scarcely evident. Head very finely and sparsely punctate. Thorax twice as wide as long, finely but distinctly punctate on apical and basal thirds, the middle almost smooth; basal striæ short, deep, distinct. Elytra oval, widest behind the middle, sides broadly curved; disc with very fine, rather sparse aciculate punctures, the basal striæ finer than and subequal in length to those of thorax. Under surface finely and sparsely punctate. Length, 1.7 mm.

Dunedin, Kissimmee, and Okeechobee City, January to April. Formerly considered by me as *B. lacustris*, but the latter is paler with elytral punctures indistinct and basal striæ longer than those of thorax. The elytra of *B. subsericeus*, when viewed in profile, often have a purplish silken iridescence. The punctures are not round and deep, but slightly elongate and shallow as though made with a fine needle held at an incline. From *B. longovalis*, *subsericeus* differs by its short, blunt form, much finer and sparser pubescence, and different punctation and much shorter basal striæ of elytra.

***Bidessus floridanus* Fall.**—This species, which I formerly confused with *affinis*, I have taken at Arch Creek, Bassenger, and Dunedin, December 1 to March 21. It is quite common in woodland ponds about Dunedin, often occurring beneath boards near their margin. It resembles closely both *fuscatus* and *affinis*. As noted above, *B. shermani* Mutchler is a synonym.

***Colambus princeps* Blatchley.**—One object of my trip to the Okeechobee region in February, 1918, was to try to find additional specimens of this large *Colambus*, but the search was a futile one, the decaying water-hyacinth and other débris along the beach being very limited.

Two mistakes were made in the description of the species as given by Leng and Mutchler. In the third line, "Antennæ and legs paler," should read "Antennæ and palpi paler," while the length should be 4.5 mm., not 5.4 mm. as there stated.

Cœlambus marginipennis Blatchley.—Since the original description was published this species has been taken sparingly by me at Dunedin, La Belle, and Moore Haven. From the other localities given by Leng and Mutchler, it seems to be widely distributed but nowhere common in southern Florida. To line one, p. 84, of their description, the words "reddish brown" should be inserted after "middle," otherwise the sentence loses its principal meaning.

Mr. Fall, in a recent letter, questions the validity of *marginipennis*, stating that it appears to him to be only "a suffused color form of *C. acaroides* Lec., with a rather coarser punctation, it having the lateral elytral carinæ present as in that species." In comparing *marginipennis* with my only Indiana specimen of *acaroides*, I find the lateral carinæ of the former much more feeble, punctation very much coarser, and the color very different, *acaroides* being dull yellow with a large common sutural spot and three discal spots on each elytron black. The matter having been referred to John D. Sherman, Jr., who has made a special study of Dytiscidæ and has a large series of both forms, he replied: "I consider *Cœlambus marginipennis* one of the most distinct species of the genus."

Hydroporus cemicoides Sharp.—This is the only species of *Hydroporus* which I have found in numbers in Florida. It has been taken at La Belle, Okeechobee City, and Dunedin, being quite frequent in the ponds about the latter place, January to April.

Hydroporus undulatus Say.—One specimen only has been taken. It was found at Sanford, March 28, and agrees with Indiana examples, but is somewhat darker.

Celina grossula LeConte.—This is the only species of the genus I have taken in the state. One specimen was found on the margin of a small pond near the University grounds at Gainesville on February 7 —

Copelatus debilis Sharp.—This species is not included in the Leng and Mutchler paper. It is a tropical form described¹ from Central America, recorded from Mexico and Panama, and not hitherto known —

¹ 1880-1882, Scientific Trans. Royal Dublin Soc., (2) XI, p. 579.

from the United States. Nine specimens were found, March 3, 1919, beneath dead leaves one-fourth mile south of the crematory and about two miles northeast of the city of Key West. No fresh-water ponds or streams are found on the island and I was much surprised to find a dytiscid inhabiting the dry land. It is probably a subarctic species breeding in brackish or salt-water pools, as the island at that point is narrow and the beetles were within 200 yards of the tidal pools on either side. Six of the nine specimens, all females, had evidently just matured, as their hue was much paler and integuments softer than the darker males. It is easily known from all our other species of the genus by having only five striae on each elytron.

***Copelatus chevrolati* Aubé.**—Occurs quite frequently about Dunedin, January to March, and also taken at La Belle. There is a short apical stria near the suture in typical *chevrolati*, which is not mentioned in the description given by Leng and Mutchler.

***Copelatus chevrolati australis* Schaeffer.**—I find among my specimens of *chevrolati* one specimen of this pale brown form, lacking the short, apical subsutural stria. It is labelled Dunedin, March 24, 1913. Not before recorded from Florida; Schaeffer giving its distribution as Texas, New Mexico, Arizona, and California.

***Copelatus glyphicus* (Say).**—My only specimen was taken beneath dead leaves in a cypress swamp, about fifty feet back from the margin of a lake near Lakeland, February 21. The Arch Creek record attributed to me by Leng and Mutchler belongs to the next species.

***Copelatus caelatipennis* Aubé.**—Only three specimens are at hand, two taken from beneath debris on the margin of Arch Creek, March 21, the other at porch light at Dunedin by my son, June 20.

***Matus bicarinatus* (Say).**—One specimen was taken at Arch Creek with the last named species and another at Dunedin in the mucky margin of Jerry Lake, January 28. The latter specimen is distinctly smaller than those from Indiana, 7.3 as contrasted with 8.5 to 9 mm., and has the elytra a uniform shining piceous, but otherwise agrees with them.

***Coptotomus interrogatus obscurus* Sharp.**—One of the more common dytiscids of the state, taken in numbers at all places where collections have been made, except Sarasota and Ormond.

Agabus semivittatus LeConte.—Leng and Mutchler state, p. 88, that "So far, no species of *Agabus* is known to occur in Florida." I have at hand six specimens, taken near Dunedin, which agree with those from Indiana bearing the above name. Mr. Sherman has examined one of the males and verified my identification. They were taken in January and February; four in woodland ponds, the others in a ditch. The range of *semivittatus* is given by Crotch as "Kansas, Colorado River, Texas and Canada," so that it is wide enough to easily include Florida.

Rhantus calidus (Fabricius).—This species is at hand from Sarasota, Dunedin, La Belle and Moore Haven. It is scarce about Dunedin but was taken in numbers at La Belle. The single Sarasota specimen was found beneath cover in a bay-head which was covered with water only at high tide.

Hydaticus bimarginatus (Say).—A dozen or more specimens have been taken about Dunedin in January and March in company with the two species of *Thermonectes* mentioned below. One was also taken in a ditch near Moore Haven, March 2. The characters separating the genera *Hydaticus* and *Thermonectes* are very feeble, the most salient one being the slightly bifid apices of the posterior tibial spurs in *Thermonectes*, these being acute in *Hydaticus*. The females of *Hydaticus* have the elytra smooth, not aciculate-punctate at base as in that sex of *Thermonectes*.

Thermonectes basilaris (Harris).—Found rarely at Dunedin and Arch Creek; common at La Belle, Moore Haven, and Okeechobee City. Varies much in size. The description of Leng and Mutchler does not mention the numerous short, deep, elongate punctures found on the basal halves of elytra of females.

Thermonectes ornaticollis (Aubé).—This species was not taken in western Florida until March 1919, when nine individuals were secured from woodland pools and ponds about Dunedin. Fresh specimens have the under surface a uniform pale reddish yellow, not reddish brown or piceous as in *basilaris*. The pale basal cross-bar of elytra is wanting, the median one on the thorax always more distinct and the size larger than in *basilaris*. I therefore regard *ornaticollis* as a valid species and not a variety of *basilaris* as placed by Leng and Mutchler.

Cybister fimbriolatus (Say).—One pair taken March 2 from the shallow margins of Lake Okeechobee, four miles southeast of Moore Haven.

HALIPLIDÆ

Haliplus punctatus Aubé.—My first specimen of this species was taken from a pond near Dunedin, January 30, 1916. Since then it has been found in small numbers each winter. It was also taken at La Belle, Moore Haven and Okeechobee City in March, 1918. The specimens from the last two stations, taken in Lake Okeechobee and Taylor's Creek, have the dark spot on front margin of thorax ill defined, and the black spots of elytra less confluent than in typical *punctatus* as found at Dunedin.

Haliplus havaniensis Wehncke.—This small species was not taken by me until December 27, 1917, when two specimens were found in a small pond within a hundred and fifty yards of my residence at Dunedin. A half-dozen or so were taken later in the same pond, and a few at La Belle on February 26.

Haliplus annulatus Roberts.—My first specimen was taken at Sarasota, March 2, 1911. It was labelled *H. lewisii*, though I recognized differences between it and the latter species found in Indiana. Mr. Mutchler has recently compared the Sarasota specimen with the type of Roberts and pronounces them the same. No others were secured until March 1919, when a half dozen were taken from the same pool in which *CælamBUS mutchleri* was found.

Peltodytes oppositus Roberts.—Occurs in some numbers in the ponds about Dunedin. Taken also at La Belle and in Taylor's Creek at Okeechobee City.

Peltodytes floridensis Matheson.—First taken near Dunedin, December 27, 1917, in the same pond with *H. havaniensis*, above mentioned. Afterwards found in some numbers in Taylor's Creek in company with the preceding. The collecting in this stream was done only at one place, viz., along the margins of a ripple just above the Fort Pierce wagon-bridge near the docks. Here, in the shallow water among the aquatic grasses and *Potamogeton*, quite a number of species of water beetles were taken with the net. This species has been recorded before only from the type locality, Sanford, Florida. It can be separated at a glance from *oppositus* by the form of the two black basal spots on the thorax. In *oppositus* these are rounded or triangular, sharply limited and widely separated. In *floridensis* they are pear-shaped and placed obliquely with the small ends almost or completely united.

GYRINIDÆ

Dineutes emarginatus (Say).—I do not find this among my Florida specimens and do not know why Leng and Mutchler give their only Florida record on my authority. It occurs in southern Indiana, but is by no means common there.

Dineutes carolinus LeConte.—This has been taken by me at practically all points where collections have been made in Florida.

Dineutes serrulatus LeConte.—Also a common species and taken at all points except Ormond. Large colonies were frequent in the Caloosahatchee River at La Belle on February 27.

Gyrinus elevatus LeConte.—This has been found by me at Dunedin, Lake Istokpoga, and Moore Haven. I have never seen large colonies, but only from one to a half dozen specimens at a time.

Gyrinus rockinghamensis LeConte.—This is a southern form originally described¹ from Rockingham, North Carolina. As pointed out by LeConte it differs from the northern *G. minutus* Fab. in its narrower and more convex form; more strongly alutaceous and therefore duller upper surface, distinctly paler under surface, and especially in the finer and much more approximate stria punctures of elytra. These differences are very evident as between numerous specimens taken about Dunedin in March 1919, and *minutus* as found in Indiana. I regard *rockinghamensis* as a valid species, or at least as a distinct southern race, and not as an absolute synonym of *minutus* as placed by Leng and Mutchler.

HYDROPHILIDÆ

Hydrochus simplex LeConte(?).—Numerous specimens at hand from Dunedin and La Belle probably belong to what Leng and Mutchler consider the *H. simplex* of LeConte, as they are the only Floridian species which I have that are 2.5 mm. in length. They have been labelled by me as *H. subcupreus* Randall(?), as they differ apparently only in size from an Indiana specimen named *subcupreus* for me by Mr. Blanchard, the northern specimen being 3.2 mm. long. One of the Florida specimens, not otherwise different, is fully 3 mm. in length. Specimens from Dunedin were sent some months ago to F. Waldo Dodge, who is especially interested in aquatic beetles, with the request that he compare them with the different species at the Cambridge Museum. After doing so he wrote: "The specimens you had labelled *subcupreus*? are not in the museum under that name, but there are identical specimens labelled *H* —

¹1868, Proc. Acad. Nat. Sci. Philadelphia, pp. 370, 373.

rufipes Mels., which is probably a synonym of *subcupreus*." I do not know whether Mr. Dodge compared them with LeConte's type of *simplex* or not. The specimens from Dunedin do not agree in some characters with LeConte's original description of that species, as he says "thorace postice vix angustato, foveisque basalibus duabus profundis," whereas they have the thorax distinctly narrowed behind and the basal foveæ not as evident as those in front. However, the elytral striæ are of the same width as the intervals, the latter being all entire except the fifth, which is slightly interrupted just behind the middle. The types of the three species, *subcupreus* Rand, *simplex* LeConte, and *rufipes* Mel-sheimer, should be gotten together and carefully compared. About Dunedin the beetle is found in company with the next species and, like it, is more often taken from the under side of immersed boards than with the net.

Hydrochus rugosus Mulsant.—Taken in small numbers in the ponds about Dunedin, December 1 to April 16. Of the fourteen specimens at hand nine are distinctly coppery above, the others dull grayish black without a trace of cupreous. All range from 5.5 to 5.7 mm. in length, and not 6 mm. as given by LeConte and Leng and Mutchler. Of Florida examples sent Dodge, he wrote: "Your specimens labelled *H. rugosus*? are in the Blanchard collection determined as 'very close to *subcupreus*' by Mr. Blanchard from Massachusetts material. Specimens in the LeConte collection from Florida are practically identical but not labelled."

Hydrochus minimus, new species

Elongate, slender. Above dark brown, distinctly bronzed, beneath piceous; antennæ and legs dull red. Head as broad as apex of thorax, rather finely and sparsely punctate. Thorax as long as wide, distinctly narrowed behind the middle, disk coarsely, deeply, and densely punctate, the front foveæ evident but faint, the hind ones obsolete. Elytra oval, widest behind the middle; the second, fourth, sixth, and eighth intervals distinctly raised and carinate throughout their length, the alternate intervals scarcely evident, the punctures of the striæ large, wider than the intervals and lying apparently in double rows, between the elevated carinæ. Length, 1.6 mm.

A single specimen of this minute species was taken from the under side of an immersed board in a pond near Dunedin on December 23, 1915. Its small size and peculiar elytral sculpture easily distinguish it from all known species.

Ochthebius foveicollis LeConte.—One specimen, taken at Dunedin December 17, represents the genus among my Florida material.

Hydræna marginicollis Kiesenwetter.—Scarce about Dunedin, December 21 to March 25, where it is taken from the under side of submerged boards about the margins of ponds, and by sifting rubbish in damp places. At La Belle, on February 26, more than fifty specimens were taken in twenty minutes in a woodland ditch where the water was running freely.

Tropisternus lateralis (Fabricius).—A very common species wherever collections have been made in Florida. It appears from the preponderance of evidence in the available literature, as well as in that furnished by numerous specimens, that the name *lateralis* should take the place of *nimbatus* Say, and that only one species exists in the eastern United States. In the original description of *nimbatus*, Say expressly states that the "lateral margin and anterior edge of the thorax are yellowish-white." LeConte,¹ referring to Say's name, says: "*Hydrophilus lateralis* Fab. is an older name of this species." Zimmermann² restored Say's name with the following words: "Differs from the South American *lateralis* Fab.; the yellow side margin is narrower and *does not extend upon the front margin of the thorax*; the hind tibiæ are often almost entirely testaceous, the elytra very finely but visibly striate, and the anal tooth long and sharp (in *lateralis* scarcely visible)." Specimens at hand from Indiana have the front margin of thorax sometimes yellow, but more often concolorous with the disk, and Say's type or types were evidently so colored, Zimmermann to the contrary notwithstanding. The marginal stripe is distinctly wider and the anal spine more prominent in the northern specimens than in those from Florida, and the legs vary much in color, thus controverting Zimmermann's statement that the wide-striped form is southern, with weak or no anal spine.

Horn, in his tabular synopsis of *Tropisternus*,³ did not follow Zimmermann but used the name *lateralis* for the species. On the next page however, he says: "Dr. Zimmermann thinks that Say's name (*nimbatus*) should be retained, inasmuch as the two species do not appear to be identical." He then dodged the question by adding: "This must however, be left for further determination." Finally, Dr. Sharp,⁴ in his "Revision of *Tropisternus*," uses the name *lateralis*, ignores *nimbatus* altogether, and gives the range of the species thus: "America, North and South, including the Antilles. United States from New York

¹Complete Writings of Thos. Say, II, p. 130.

²1869, Trans. American Ent. Soc., II, p. 249.

³1876, Trans. American Ent. Soc., V, p. 251.

⁴1883, Trans. Ent. Soc. London, part 2, p. 111.

southwards, abundant; Mexico and Central America, abundant; Cuba, Antigua, St. Thomas; Rio Janeiro, Constancia, Buenos Ayres, Chili." He speaks of the great variation in the "width and regularity of the yellow cincture on the head, thorax and wing-cases," and also in that of the "armature of the last ventral plate," and states: "I have been quite unable to arrange the numerous variations in such a way as to indicate distinct species; nevertheless it may prove that there is more than one truly distinct species mixed under the name *lateralis*."

We have, therefore, the direct or implied opinions of LeConte, Horn, and Sharp, three of the greatest Coleopterists the world has produced, as against that of Dr. Zimmermann. Moreover, we have the known variation in the color of the insect itself. On whose opinion Henshaw replaced *lateralis* by *nimbatus* in his Check List I know not, but I believe that the name *lateralis* only should be used, and *nimbatus* permanently relegated to synonymy.

Tropisternus sublævis (LeConte).—This species was first recorded from Florida by the writer,¹ the record being based on Dunedin specimens taken in ponds in January and February, and at porch light in June. Since then it has been taken by me at La Belle and Moore Haven, and a specimen from Arch Creek was found among those labelled *glaber*.

Tropisternus glaber (Herbst).—I have found this a scarce species in Florida, my only specimens being from Ormond, Moore Haven, and Dunedin.

Tropisternus striolatus (LeConte).—Dunedin, Lakeland, Fort Myers, La Belle, Moore Haven, and Arch Creek; frequent, December to June. The specimens from Fort Myers and part of those from Dunedin were taken at light. All my Florida specimens differ from those from Indiana in having the thorax very narrowly margined with yellow and the pale stripes of elytra vague or subobsolete. In some of the northern specimens the yellow predominates, while in all of them the pale elytral stripes are distinct. Sharp (*loc. cit.*, p. 99) notes this variance in color and suggests that it may indicate two distinct species, the dark one being new.

Hydrophilus ovalis Ziegler.—I have taken this large species only at light at Fort Myers and Sanford, March 11 to April 3. It is the *H. ovatus* Gemminger and Harold of my "Coleoptera of Indiana."

¹1918, *Canadian Ent.*, L, p. 52.

Hydrocharis castus (Say).—Taken in small numbers at Dunedin, Fort Myers, La Belle, Moore Haven, and Arch Creek, January to April.

Berosus pugnax LeConte.—This species was not in my collection until March 1, 1918, when I took six in the shallow water of Lake Okeechobee, southeast of Moore Haven.

Berosus infuscatus LeConte.—I have found this the most widely distributed species of the genus in Florida, it having been taken at nearly every place collecting was done; January to March. In addition to the differential characters between this species and *striatus* given by Leng and Mutchler, it may be added that the surface is finely but distinctly alutaceous in *infuscatus*, smooth in *striatus*.

Berosus exiguus (Say).—This minute form is at hand only from Dunedin and La Belle, three of the six specimens having been taken at porch light in June and sent to me.

Berosus striatus (Say).—Only four specimens have been taken, two at Ormond, April 6, the others at Moore Haven and Dunedin, March 2 and June 20; on the latter date at light. It is our most common species in Indiana.

Berosus aculeatus LeConte.—Not discovered until my last trip to Lake Okeechobee, when a dozen specimens were secured at La Belle and Moore Haven.

Chaetarthria pallida (LeConte).—The same is true of this minute species, my only Florida specimen having been taken at lamp light in a tent near Moore Haven on March 2.

Derallus altus (LeConte).—This species is not included in Leng and Mutchler's paper. A single specimen was taken beneath a board on the margin of a pond one mile east of Dunedin, January 16, 1916, and a half dozen others were dredged from the same pond in March 1919. It was described from Louisiana and is a small (2 mm.) black, feebly bronze species, the form oval, very convex and strongly compressed. LeConte placed it in *Berosus*, but Sharp erected for it the genus *Derallus*.

Helochares maculicollis Melsheimer.—Taken only at Dunedin where it is scarce; December 28 to April 1.¹

¹An account of the egg-carrying habits of the female, as shown by a Dunedin specimen, will found in Canadian Ent., XLIX, 1917, p. 139.

Philhydrus cinctus (Say).—One specimen taken at Dunedin, March 9; my others so labelled proving to be *consors*.

Philhydrus consors LeConte.—A scarce species about Dunedin, December to April. Not taken elsewhere.

Philhydrus nebulosus (Say).—Dunedin, Moore Haven, and Okeechobee City; not common in Florida so far as my collecting shows.

Philhydrus ochraceus Melsheimer.—One of the most common hydrophilids of the state, taken at practically all collecting stations. Varies much in size, some of the smaller examples being only 2.3 mm. in length.

Philhydrus perplexus LeConte.—Dunedin, Sarasota, La Belle, and Moore Haven; frequent, January to April.

Cymbiodyta fimbriatus Melsheimer.—Kissimmee, Sarasota, Dunedin, and Moore Haven; scarce, December to March. It is my opinion that the generic name *Cymbiodyta* Bedel should be retained for this and allied species.

Creniphilus nanus Fall.—This species, so named for me by Mr. Fall, is quite common about Dunedin and apparently widely distributed throughout Florida, having been taken at Sanford, Lakeland, Kissimmee, Bassenger, and Moore Haven; February to April. It often occurs beneath dead water-hyacinth and other débris on the margins of lakes, as well as in the water.

Creniphilus reductus Fall.—A single specimen taken at Arch Creek, March 21, I refer to this species. It is distinctly shorter and more convex than *nanus*, and has the surface alutaceous and more coarsely punctate.

SPHÆRIDIDÆ

Phænonotum estriatum (Say).—Taken at all points where collections have been made except Ormond; January to April. Occurs especially beneath boards near springs, and occasionally taken by sweeping.

Phænonotum semiglobosum (Zimmermann).—Much less frequent than the preceding, Sarasota and Dunedin being the only stations represented; February to March.

Oösternum costatum Sharp.—A single specimen was taken March 7, from beneath decaying water-hyacinth on the beach of Pelican Bay, near the southeastern corner of Lake Okeechobee. My tentative determination was confirmed by Mr. Mutchler.

Cercyon prætextatum (Say).—Taken in small numbers only at Kissimmee, La Belle, Okeechobee City, and Dunedin; January to March. Found more often beneath cover on the borders of ponds and lakes than in the water.

Cercyon floridanum Horn.—Dunedin, Kissimmee, and Lake Okeechobee at Moore Haven and Palm Beach Canal; February to March. Occurs also beneath débris and at light.

Cercyon variegatum Sharp.—Represented by one specimen taken at Sarasota, February 14. It lacks the usual piceous spots of thorax and elytra, but otherwise agrees with the descriptions.

PARNIDÆ

The only species of this family which I have so far taken in Florida is

Pelonomus obscurus LeConte.—Five specimens are at hand, two from Arch Creek, March 21; one from Sarasota, January 31, and two from Dunedin, taken at porch light, July 22 and September 20. All agree in every particular with LeConte's description,¹ their color being dark piceous-brown, and not dark red-brown as Casey describes his *rufescens*.

¹1852, Proc. Acad. Nat. Sci. Philadelphia, VI, p. 42.

**Article V.—DESCRIPTIONS OF PROPOSED NEW BIRDS FROM
PERU, BOLIVIA, ARGENTINA, AND CHILE**

BY FRANK M. CHAPMAN

The birds herein described were 'discovered' chiefly during the study of a collection from the Urubamba region of southern Peru made by Edmund Heller in 1915, George K. Cherrie, H. Watkins and the writer in 1916, and by H. Watkins in 1917, acting as parts of the Yale University—National Geographic Society Expedition, the archæological work of which, under the direction of Professor Hiram Bingham, is so widely known.

A detailed paper on the birds secured from the source of the Urubamba River at La Raya, at an altitude of 14,000 feet, to its entrance to the Amazonian forests in the humid Tropical Zone, is in preparation. Meanwhile it is considered desirable to publish the following descriptions of birds secured by the expedition, and with them are included descriptions of certain other forms, collected for the American Museum mainly by Leo E. Miller and Howarth Boyle in Bolivia and Argentina, which these studies have shown to be apparently unnamed.

The color terms employed are those of Ridgway's 'Color Standards and Color Nomenclature' (Washington, 1912).

I have recently had occasion to use numerous reprints or authors' 'extras' of papers on Peruvian birds. Their lack of consistency in the arrangement of species with the absence of indices detracts greatly from their reference value and emphasizes anew the desirability of adopting as a standard some one classification. I take the liberty, therefore, of repeating my plea for the employment of the classification of Brabourne and Chubb's 'Birds of South America,' by the authors of papers on the birds of that continent.

***Microsittace ferrugineus minor*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Microsittace ferrugineus ferrugineus* (Müll.) of the Magellan region, but much smaller with an actually stouter bill, general color slightly darker, less yellow green, the red abdominal patch averaging darker in color and much smaller in area, the forehead and lores redder, less grayish.

TYPE.—No. 1534, Brewster-Sanford Coll., ♂ ad., Corral, Chile, Oct. 4, 1913; R. H. Beck.

SPECIMENS EXAMINED.—*Microsittace ferrugineus minor*. Chile: type locality, 2 ♂♂, 1 ♀; Temuco, 2 ♂♂, 2 ♀♀.

Microsittace ferrugineus ferrugineus. Chile: Tierra del Fuego, 4 ♂♂, 3 ♀♀; Beagle Channel, 1 ♂. Argentina (Patagonia): Rio Chico, Cordilleras, 2 ♀♀.

MEASUREMENTS				
	Locality	Sex	Wing	Tail
			mm.	mm.
<i>M. f. minor</i>	Corral, Chile	♂	178	155
"	" "	♂	173	149
<i>M. f. ferrugineus</i>	Tierra del Fuego, Chile	♂	202	178
"	" "	♂	201	186
<i>M. f. minor</i>	Corral, Chile	♀	169	140
"	Temuco, "	♀	175	150
<i>M. f. ferrugineus</i>	Tierra del Fuego, Chile	♀	192	168
"	" "	♀	197	169

REMARKS.—This is a well-marked form for which there appears no earlier available name, *Psittacus smaragdinus* Gm. being a synonym of *ferrugineus* while *Conurus pyrrhurus* Rehb. is a *nomen nudum*.

Two specimens from southern Patagonia (Cordilleras of the Rio Chico) while closely agreeing with Tierra del Fuego birds in color, more nearly resemble Corral, Chile, examples in size and, as intermediates, indicate the intergradation of the southern and northern forms of this species.

Upucerthia dumetoria hallinani, new subspecies

SUBSPECIFIC CHARACTERS.—Similar to *Upucerthia dumetoria dumetoria* Geoff. St. Hilaire of the Patagonia region, but paler throughout and smaller, the bill proportionately longer, the back grayer, less olivaceous, the breast with less fulvous, the dusky margins to the feathers narrower, the abdominal region whiter, the sides and flanks only slightly tinged with ashy. ♂ wing, 98; tail, 78; tarsus, 25; culmen, 33 mm.

TYPE.—No. 147,372, Amer. Mus. Nat. Hist., ♂ ad., Tofo. 60 miles north of Coquimbo, Chile, June 3, 1917; Thomas Hallinan.

SPECIMENS EXAMINED.—*Upucerthia dumetoria hallinani*. The type.

Upucerthia dumetoria dumetoria. Argentina: Rio Gallegos, 3. Chile: Punta Arenas, 1.

Upucerthia dumetoria darwini. Argentina: Mendoza, 3; Tafi del Valle, 7000 ft.—8; Angaco Sud, Prov. San Juan, 5; Media Agua, Prov. San Juan, 3.

Upucerthia dumetoria saturator. Chile: Santiago, 1; Valparaiso, 2.

REMARKS.—The characters of this race are so well-marked and so i keeping with those which the arid nature of its habitat would lead om to expect that its description from but a single specimen seems justified. I have much pleasure in naming this north Chilean form after its colector Mr. Thomas Hallinan who, although much occupied by his dutie

as an engineer, has, nevertheless, found time at his various posts in tropical America to secure specimens which have formed most acceptable additions to our collections.

***Upucerthia dabbenei*, new species**

SPECIFIC CHARACTERS.—With a general resemblance to *Upucerthia pallida* from La Raya, Peru, but smaller, the upperparts grayer, the underparts nearly uniform light pinkish cinnamon, the median tail-feathers sepia.

TYPE.—No. 141,021, Amer. Mus. Nat. Hist., ♀ ad., above Tafi del Valle, alt. 9500 ft., Prov. Tucuman, Argentina, April 1, 1916; Miller and Boyle.

DESCRIPTION OF TYPE.—Upperparts practically uniform grayish Saccardo's umber; underparts, including sides and crissum, between light pinkish cinnamon and cinnamon-buff; superciliary, slightly deeper, bend of wing and under wing-coverts appreciably deeper and clearer in tone; throat and upper breast faintly margined with dusky; ear-coverts mixed with colors of upper and underparts; four outer pairs of rectrices orange-cinnamon, deepening in tone from without inwardly, fifth pair still deeper, the central pair sepia; outer primary largely fuscous-black, remaining primaries and secondaries orange-cinnamon tipped with fuscous-black, this color extending down the inner vane of the second and third primaries (from without); outer vane of outer primaries grayish; primary coverts orange-cinnamon tipped with dusky, greater coverts darker and browner; inner wing-quills approaching the color of the back, their centers darker; bill and feet black (in skins). Wing, 94; tail, 80; tarsus, 28; culmen, 36 mm.

DESCRIPTION OF MALE.—Resembles the female in color but is larger. Wing, 99; tail, 87; tarsus, 29; culmen, 35.

SPECIMENS EXAMINED.—*Upucerthia dabbenei*. Argentina: type locality, 8. *Upucerthia pallida*. Peru: Tirapata, 8; La Raya, 2.

REMARKS.—It gives me unusual pleasure to dedicate this apparently well-marked species to Dr. Robert Dabbene, Curator of Zoology in the National Museum of Argentina at Buenos Aires, to whose untiring and long-continued labors we owe so large a part of our exact knowledge of the Argentine Ornis. *Upucerthia dabbenei* differs from any species of the genus known to me in its richly colored underparts which, except for the slight squamations of the throat and breast, are wholly uniform in color.

It may require comparison with *Upucerthia validirostris*, of which I have seen no specimens; but the latter species is described as having the underparts "pale buffy white," the tail as "nearly uniform reddish cinnamonous," and neither of these descriptions can be applied to the species here proposed.

***Cinclodes fuscus tucumanus*, new subspecies**

SUBSPECIFIC CHARACTERS.—Most nearly related to *Cinclodes fuscus rivularis* (Cab.) of Peru, but darker above (Prout's brown rather than cinnamon-brown), the colors of the wing everywhere deeper, the whitish or pale buff areas on the quills and primary coverts of *rivularis* replaced by ochraceous-buff much as in *fuscus fuscus*; margin of the greater coverts distinctly paler.

TYPE.—No. 141,044, Amer. Mus. Nat. Hist., ♂ ad., above Tafi del Valle, alt. 9500 ft., Prov. Tucuman, Argentina, April 2, 1916; Miller and Boyle.

SPECIMENS EXAMINED.—*Cinclodes fuscus tucumanus*. Argentina: type locality, 9.

Cinclodes fuscus fuscus. Argentina: Barracas al Sur, 1; Mar del Plata, 1; Rio Gallegos, 1. Chile: Cape Horn, 3; Caroline Island, 1; London Island, 2; Londonderry Island, 2; Temuco, 1; Tofo, 60 m. north of Coquimbo, 1.

Cinclodes fuscus rivularis. Bolivia: Cuchacancha, 11,000 ft., Prov. Cochabamba, 39; Incachaca, 7700 ft., Prov. Cochabamba, 1; Vinto 8600 ft., Prov. Cochabamba, 5; Parotani, 8800 ft., Prov. Cochabamba, 3. Peru: Puno, 12,500 ft., 1; Tirapata, 12,700 ft., 7; La Raya, 14,000 ft., 6; near Cuzco, 11,500 ft., 5; Huatacondo Cañon, 10,000 ft., 2; Ollantaytambo, 9700 ft., 1; above Machu Picchu, 12,000–14,000 ft., 2; Idma Pampa, 11,200 ft., 1; Oroya, 12,100 ft., 5 (topotypical); Junin, 12,900 ft., 1 (topotypical).

REMARKS.—Our large series of *Cinclodes fuscus* not only enables me to determine the status of the form inhabiting the Sierra west of Tucuman but also to add somewhat to our knowledge of the extent of the ranges of certain other forms of this species. Thus *Cinclodes fuscus fuscus* ranges as far north at least as Tofo, 60 miles north of Coquimbo, without showing any approach in color to *rivularis*, while the latter form appears to occupy most, if not all, the range of the species in Peru. Some specimens in our large series from Bolivia have the band in the *secondaries* quite as richly colored as in *tucumanus*, but the band in the *primaries* is always whiter in the Bolivian birds.

In the general color of the wing *tucumanus* resembles true *fuscus* but the primary coverts are largely ochraceous-buff instead of largely black narrowly margined with white or fulvous. In the color of the upperparts the two forms are quite unlike, *fuscus* being olive-brown, *tucumanus* Prout's brown. The latter form is therefore darker above than any other in the group, while *fuscus* is the palest. It is interesting to observe that the markings of the wing evidently reach their palest color in true *rivularis* from the Junin region, since in the Ecuador race, *albidiventris*, they are even much deeper than in *tucumanus*, and in *heterurus* of the Mérida Andes these colors reach their maximum of intensity. From central Peru, therefore, both northward and southward, the wing markings in *Cinclodes fuscus* increase in the richness of their coloring.

***Leptasthenura punctigula*, new species**

SPECIFIC CHARACTERS.—Most closely resembling *Leptasthenura ægithaloides berlepschi* Hart. of Argentina, but white throat area spotted with black, outer tail-feathers largely pale cinnamon, median ones sepia, crown paler, crested, etc.

TYPE.—No. 141,054, Amer. Mus. Nat. Hist., ♂ ad., Sarmiento, alt. 1700 ft., Prov. Tucuman, Argentina, May 30, 1916; Miller and Boyle.

DESCRIPTION OF TYPE.—Upperparts grayish drab of essentially the same color as in *Leptasthenura ægithaloides berlepschi*, rump and upper tail-coverts more fulvous, crown darker with cinnamon-buff streaks which extend backwards centrally on the elongated feathers of a well-defined crest; lores and superciliary white; auriculars whitish margined with the color of the back; tail formed as in *ægithaloides*; central pair of rectrices sepia, succeeding pair somewhat darker—the four outer feathers pale cinnamon terminally, this color increasing in extent from nearly the terminal third or half of the innermost to nearly all of the outer one, these feathers basally blackish; wings of about the same color as the median rectrices, the quills and coverts margined with pale cinnamon; an orange tawny band at the base of the inner wing-quills; underparts soiled whitish, a not sharply defined white throat- and upper breast-area with small blackish pointed spots, two of which are generally on each feather; sides, flanks and crissum washed with pale cinnamon; legs and feet black, bill blackish, the maxilla pale basally. Wing, 62; tail, 82; tarsus, 16.5; culmen, 9 mm.

DESCRIPTION OF FEMALE.—The female resembles the male.

SPECIMENS EXAMINED.—*Leptasthenura punctigula*. Argentina: type locality, 2; Lavalle, Santiago del Estero, 2.

Leptasthenura ægithaloides berlepschi. Argentina: Angaco Sud, Prov. San Juan, 3; Media Agua, Prov. San Juan, 9; Mendoza, Prov. Mendoza, 2; Santa Cruz, Prov. Santa Cruz, 2.

REMARKS.—This new species differs from *berlepschi* too radically to be considered a representative of that species which, indeed, was described from the Province of Tucuman, though from a much higher altitude than the type locality of *punctigula*.

***Leptasthenura andicola peruviana*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Leptasthenura andicola andicola* of Ecuador, but crown light cinnamon-rufous instead of dark hazel, the black margins much narrower, the malar region and throat whiter, the lores and auriculars more rufescent, the back more broadly streaked with white, the wing-coverts and tertials narrowly but distinctly margined with pale cinnamon-rufous, markings near and at the base of the inner wing-quills pale cinnamon-rufous and more evident, tail longer. Wing, 74; tail, 95; culmen, 11 mm.

TYPE.—No. 273,001, U. S. Nat. Mus., ♀, La Raya (Alt. 14,000 ft.), Peru, April 12, 1917. H. Watkins.

SPECIMENS EXAMINED.—*Leptasthenura andicola peruviana*. Peru: the type.

Leptasthenura andicola andicola. Ecuador: Chimborazo, 13. Colombia: Paramo of Sta. Isabel, 4.

REMARKS.—This is evidently the bird described by Taczanowski (Orn. du Pérou) as *Leptasthenura andicola*, a species which it doubtless represents but from which it is unquestionably subspecifically and perhaps specifically distinct.

***Siptornis urubambensis*, new species**

SPECIFIC CHARACTERS.—Size of *Siptornis flammulata* to which it bears a general resemblance in the color of the underparts, but upperparts Prout's brown, the streaks obscure ochraceous-buff and extending little, if any, posterior to the nape; tail uniform, of about the same color as the back, without rufous.

TYPE.—No. 273,006, U. S. Nat. Mus., ♂ ad., Machu Picchu, above timberline, 14,000 ft., Peru, June 5, 1915; E. Heller.

DESCRIPTION OF MALE.—Upperparts Prout's brown, forehead and nape finely streaked with ochraceous-buff, these streaks obsolete or wanting on the pileum; the back uniform, unstreaked except, in one specimen, slightly at its junction with the nape; a well-defined whitish superciliary reaches to a level with the back of the auriculars which are whitish margined with blackish brown and bordered posteriorly by a large area on the side of the neck streaked with ochraceous-buff and whitish margined with brownish black; tail sharply pointed, like that of *flammulata*, of essentially the same color as the back; wing-quills darker, the inner ones and exterior margins of outer ones colored like the back; inner primaries and secondaries basally orange-tawny, under wing-coverts deep ochraceous-orange; throat and breast whitish, more or less tinged with buffy, the feathers laterally margined with blackish, giving these parts a strongly streaked appearance; chin-square ochraceous-buff to ochraceous-orange; sides and flanks washed with the color of the back and streaked with whitish; center of the abdomen soiled whitish, unstreaked; toes brownish black, tarsi browner; bill black, the maxilla horn-color basally. Wing, 57–61; tail, 76–85; tarsus, 23–24; culmen, 14 mm.

DESCRIPTION OF FEMALE.—The female resembles the male.

SPECIMENS EXAMINED.—*Siptornis urubambensis*. Peru: type locality, 1 ♂, 1 ♀; Machu Picchu (Cedrobamba, 12,000 ft.), 1 ♂, 2 ♀ ♀.

Siptornis flammulata flammulata. Ecuador: Mt. Chimborazo, 11; near Quito, 2.

REMARKS.—This bird appears to be only distantly related to the *flammulata* group of which *Siptornis taczanowskii* Berl. and Stolz. is evidently the Peruvian representative. It is much smaller than *S. virgata* which, furthermore, has a differently colored tail and underparts, and it is also quite unlike *maculicauda*, in which the underparts are not streaked.

***Siptornis punensis rufala*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Siptornis punensis punensis* Berl. of southern Peru and Bolivia, but blackish markings of the upperparts more guttate, less linear; margins of the tertials more rufescent, wing-coverts largely orange-tawny; markings of the wing-quills usually deeper in tone and always more extensive, occupy-

ing practically all the outer as well as inner web of the primaries from the beginning of the 'notch' (on the outer primary at a point opposite the notch on the one adjoining) to, or near the base; tail shorter, ranging from 74–84 mm. in the male as compared with 90–94 mm. in *punensis punensis*.

TYPE.—No. 141,178, Amer. Mus. Nat. Hist., ♂ ad., above Tafi del Valle, alt. 9500 ft., Prov. Tucuman, Argentina, April 2, 1916; Miller and Boyle.

SPECIMENS EXAMINED —*Siptornis punensis rufala*. Argentina: type locality, 12.

Siptornis punensis punensis. Bolivia: Cuchacancha, 11,000 ft., 11.

REMARKS.—This is a form of the *graminicola* group which appears not to have been before recorded from Argentina, unless *Siptornis lilloi* Oust. may be so considered. I have not seen this species which was described from the region in which the bird here named occurs. Its relationships, however, are said to be with *S. hudsoni* while the median rectrices are described as "strictis pallide fulvis" and again as "bien plus claire," descriptions which cannot be applied to *rufala*.

***Pseudochloris uropygialis connectens*, new subspecies**

SUBSPECIFIC CHARACTERS.—Most nearly related to *Pseudochloris uropygialis uropygialis* (d'Orb. and Lafr.) of Bolivia, but male with anterior portion of auriculars and, usually, region below the eye olive-yellow, yellow more extensive on sides and flanks; female with the whole head yellower than in *Pseudochloris uropygialis uropygialis*.

TYPE.—No. 273,002, U. S. Nat. Mus., ♂ ad. (testes much enlarged), La Raya (Alt. 14,000 ft.), Peru, April 5, 1917; H. Watkins.

SPECIMENS EXAMINED.—*Pseudochloris uropygialis connectens*. Peru: type locality, 4 ♂♂ 2 ♀♀ (Apr. 5–7); near Cuzco, 1 ♂ juv. (July 2); Tirapata, 2 ♀♀ (July 29, 30); Puno, 3 ♂♂ (Jan. 19–21), 3 ♂♂ (Aug. 7–11), 2 ♀♀ (Jan. 19–22), 1 ♀ (Aug. 8).

Pseudochloris uropygialis uropygialis. Bolivia: Cuchacancha, Prov. Cochabamba, 5 ♂♂, 2 ♀♀ (June 13–18); Oruro, 1 ♂ (Feb. 2).

Pseudochloris uropygialis sharpei. Peru: Junin, 3 ♂♂ (Mar. 23–Apr. 3).

REMARKS.—This proposed new form is an intermediate between *Pseudochloris uropygialis sharpei* of the Lake Junin region and *Pseudochloris uropygialis uropygialis* of Bolivia. Although the bird is common on the tableland of southern Peru, previous authors seem not to have had specimens from that region. Both Taczanowski (Orn. du Pérou) and Sharpe (Cat. B. M.) refer only to Junin specimens, and Berlepsch and Stolzman (1894, Ibis, p. 386), in later describing the Junin form as *sharpei*, seem to have had only Bolivian examples for comparison.

Puno specimens more nearly approach true *uropygialis* than do those from La Raya, some of which have the ear-coverts largely greenish

and thus, in respect to this character, are nearer *sharpei*. The new form, therefore, indicates that *sharpei* and *uropygialis* are not specifically distinct.

***Pseudochloris olivascens sordida*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Pseudochloris olivascens olivascens* (d'Orb. and Lafr.) of Bolivia, but male much darker throughout, the feathers of the upperparts with dusky centers, the yellow of the underparts several shades deeper, the throat and breast strongly tinged with olivaceous.

TYPE.—No. 142,237, Amer. Mus. Nat. Hist., ♂ ad., Ticara, alt. 8000 ft., Prov. Jujuy, Argentina, Feb. 10, 1916; Miller and Boyle.

SPECIMENS EXAMINED.—*Pseudochloris olivascens sordida*. Argentina: type locality, 2 ♂ ads., 5 ♀ ads. (Feb. 8–12).

Pseudochloris olivascens olivascens. Bolivia: 1 ♂ ad., 1 ♀ im. ex Berlepsch, no locality; Oruro, 1 ♂ ad. (Feb. 2); Cuchacancha, Prov. Cochabamba, 1 ♂ im., 1 ♀ im. (June 16–18).

REMARKS.—This well-marked form extends the known range of *Pseudochloris olivascens* into Argentina. The four females mentioned above, like the males, are in worn breeding plumage and are not comparable with my Bolivian females of *olivascens* which are immature birds in first plumages. The Argentine birds are dusky brown above with only slight traces of greenish, while the yellow below is more or less washed with brownish.

The Oruro male and Bolivian specimen without exact locality are seasonally comparable with the Argentine kinds toward which the Oruro specimen makes an obvious approach in its duskier coloration.

***Atlapetes canigenis*, new species**

SPECIFIC CHARACTERS.—Most nearly resembling *Atlapetes castaneifrons* Sel. and Salv., of Venezuela, but with no white malar stripe, or black mystacial streak: ante-orbital region grayish black.

TYPE.—No. 273,003, U. S. Nat. Mus., ♂ ad., Torontoy (Alt. 9500 ft.), Urubamba Cañon, Peru, May 2, 1915; E. Heller.

DESCRIPTION OF MALE. Crown between orange-rufous and Sanford's brown, this color extending to the nape where slightly paler, bordered by a black stripe from in front of the eye to the posterior margin of the dark, shining gray auriculars; back deep neutral gray, wings and tail blackish, the primaries narrowly margined with grayish externally; underparts, including sides of the throat, nearly uniform gray, paler than upperparts, in some specimens slightly lighter on the throat and center of the belly; a slight tinge of fulvous on the inner edges of the wing-quills. Wing, 76; tail, 78; tarsus, 27; culmen, 15.5 mm.

DESCRIPTION OF FEMALE.—The female resembles the male in color but is slightly smaller. Wing, 72; tail, 72; tarsus, 25; culmen, 15 mm.

SPECIMENS EXAMINED.—*Atlapetes canigenis*. Peru: Torontoy, 1 ♂, 3 ♀♀; Occabamba Valley, 1 ♀.

Atlapetes castaneifrons. Venezuela: Merida, 2 ♂♂, 1 ♀, 4?

REMARKS.—The marked tendency of the genus *Atlapetes* to develop new forms, some of which have an extremely restricted range, is well illustrated by the present species. Although it has apparently escaped previous collectors, including Kalinowski, who worked in the region it inhabits, it is evidently not a rare species, since Heller secured four specimens and Chapman one. All were taken in the Subtropical Zone to which most species of the genus are confined.

It is interesting to note that the species which most nearly resembles *canigenis* is known only from the Andes of Merida, Venezuela.

***Diglossa mystacalis albilinea*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Diglossa mystacalis mystacalis* Lafr. of Bolivia, but with the mystacal stripe light ochraceous-buff or creamy white anteriorly, more ochraceous posteriorly, instead of "pale red" (Ex. Lafr. and Sc.) or tawny; and consequently resembling in this character *Diglossa pectoralis* Cab.

TYPE.—No. 273,005, U. S. Nat. Mus., ♂ ad., Machu Picchu, alt. 12,000 ft. (timberline), ruins Cedrobamba, May 26, 1915 (breeding); E. Heller.

DESCRIPTION OF JUVENAL.—Resembling the adult but less glossy, especially below, where more or less streaked with ochraceous; crissum paler, bill paler, mandible largely yellowish flesh-color.

SPECIMENS EXAMINED.—*Diglossa mystacalis albilinea*. Peru: type locality, 3 ad. ♂♂, 1 ad. ♀, 2 im. ♂♂.

Diglossa mystacalis mystacalis.—Plate 1, Cat. Birds B.M., XI.

Diglossa pectoralis.—Pl. IV, Ibis, 1875.

REMARKS.—The excellent plates above mentioned, with the fine series of specimens secured by Heller, of this proposed new form, war-rants, in my opinion, its description without comparison with actual specimens of its nearest relative. The species has not before been recorded from Peru, indicating that Peruvian specimens have not heretofore come to the attention of ornithologists, and, furthermore, the character by which the new race evidently departs from the type form is a normal and to be expected variation since it is shown by *Diglossa pectoralis*, another species of this group.

***Oreomanes binghami*, new species**

SPECIFIC CHARACTERS.—Similar to *Oreomanes fraseri* Sc. of Ecuador, but *super-ciliary* stripe, malar region, and chin white instead of chestnut; wings and tail *grayer*; *bill* longer and stouter, median portion of culmen flattened.

TYPE.—No. 273,004, U. S. Nat. Mus., ♀ ad., Cedrobamba Ruins, Machu Picchu, alt. 12,000 ft. (timberline), Peru, June 13, 1915; E. Heller.

DESCRIPTION OF TYPE.—Upperparts between slate-gray and deep neutral gray, crown blackish, lightly edged with gray; slight traces of black on the back and of chestnut on upper tail-coverts; superciliary streak, auriculars, malar region and chin white; a broad but broken black mystacial stripe; wings and tail fuscous margined externally with the gray of the back; underparts including lower tail-coverts, excluding chin, bright chestnut; tibiae grayish; tarsi blackish brown; toes darker; maxilla black, mandible browner, cutting edge and tip of both horn-color. Wing, 85; tail, 60; tarsus, 21; culmen, 24 mm.

SPECIMENS EXAMINED.—*Oreomanes binghami*. Peru: the type.

Oreomanes fraseri. Ecuador: Mocha Cañon, 11,000 ft., Mt. Chimborazo, 1 ♂, 1 ♀.

REMARKS.—This interesting new species is dedicated to Prof. Hiram Bingham, organizer and leader of the Yale University-National Geographic Society Expedition, to whose vision, energy, and executive ability we owe not only our knowledge of the Inca city of Machu Picchu, near which it was discovered, but also the collection of which it forms a part.

Oreomanes fraseri, heretofore the only described species of this strongly characterized genus, is known only from the humid temperate zone of Ecuador, the type having come from Mt. Chimborazo. The discovery of the species here described therefore not only adds a second species to the genus but extends its known range nearly 1000 miles to the south.

***Tangara cyaneicollis gularis*, new subspecies**

SUBSPECIFIC CHARACTERS.—Most nearly related to *Tangara cyaneicollis cyaneicollis*, but male with the head darker blue, of about the same shade as in *Tangara cyaneicollis caeruleocephala*, but with no purple on the forehead and little if any on the throat.

TYPE.—No. 146,510, Amer. Mus. Nat. Hist., ♂ ad., Candamo, Tropical Zone, S. E. Peru, Dec. 10, 1916; H. Watkins.

SPECIMENS EXAMINED.—*Tangara cyaneicollis gularis*. Peru: Candamo, 3 ♂♂; Santo Domingo, 1 ♀; Astillero, 1 ♀; Rio San Miguel, Urubamba Cañon, 1 ♂.

Tangara cyaneicollis cyaneicollis. Bolivia: Yungas, Prov. Cochabamba, 4 ♂♂, 2 ♀♀.

Tangara cyaneicollis caeruleocephala. Ecuador: Marañon, 4 ♂♂; Zamora, 4 ♂♂, 2 ♀♀. Colombia: 10 ♂♂, 9 ♀♀.

REMARKS.—This is a slightly differentiated form of this variable species, intermediate between *cyaneicollis* and *caeruleocephala*, with, roughly speaking, the head of one and the throat of the other and there-

fore not properly referable to either. It evidently occupies a considerable area in southeastern Peru since our specimens are from localities as widely separated as the lower Urubamba Valley and the Rio Tambopata.

***Amblycercus holosericeus australis*, new subspecies**

SUBSPECIFIC CHARACTERS.—Most nearly resembling *Amblycercus holosericeus holosericeus* (Licht.) but wing averaging shorter, tail longer, bill more slender, its plumbeous color confined to base and gonys, the remainder more straw-color, less horn-color.

TYPE.—No. 138,594, Amer. Mus. Nat. Hist., Incachaca (Alt. 7700 ft.), Prov. Cochabamba, Bolivia, May 12, 1915; Miller and Boyle.

SPECIMENS EXAMINED.—*Amblycercus holosericeus australis*. Bolivia: Incachaca, 1. Peru, Urubamba Valley, 2.

Amblycercus holosericeus holosericeus. Mexico, 12. Guatemala, 2. Costa Rica, 3. Panama, 7.

Amblycercus holosericeus flavirostris. Colombia, 7. Ecuador, 8.

MEASUREMENTS						Depth of
	Sex	Wing	Tail	Tarsus	Culmen	Bill at
		mm.	mm.	mm.	mm.	Base
						mm.
<i>A. h. holosericeus</i>	(5 ♂ ♂)	100-106	98.5-109	32.5-34	29.5-33	13.5-14.5
<i>A. h. flavirostris</i>	(4 ♂ ♂)	96-99	92.0- 96	30-32.5	28.0-31	13.5-14.5
<i>A. h. australis</i>	(2 ♂ ♂)	92-98	104 -114	31-32	29	13

REMARKS.—The proposed new form appears to be from the southern limit of the range of the species, indeed I find no previous record of it for Bolivia. Although most nearly resembling the Mexican and Central American race it is geographically separated from it by the form occupying Ecuador and Colombia, which is easily recognized by its yellow bill. The differences in shape and size of the bill of *australis* and the northern forms are not readily expressed in figures but are clearly evident on comparison. In true *holosericeus* the whole bill is, in some specimens, largely plumbeous, and this color usually runs to the tip of the bill along its commissure, on the culmen, or both, while in *australis* the plumbeous color is confined to the gonys and basal portion of the bill with a slight trace of it, if any, on the apical part of the culmen.



Article VI.—SEVERTZOW'S CLASSIFICATION OF THE FELIDÆ

By J. A. ALLEN

Severtzow gave at the end of his article on the geographical distribution and geographical variation in the Carnivores, and especially in the Felidæ, a "classification géographique des Chats,"¹ in which he divided the family into five genera and twenty-seven subgenera. This classification was merely an outline, to be filled in later in another work which appears to have never been published.² He approached the subject from the geographical side,³ the distribution of the cats and their faunal relationships being the main points considered, the taxonomic and nomenclatural features being necessary adjuncts. That he selected his subgeneric groups intelligently is beyond question. Their availability is due to clear judgment of their relationships and to his designation in most cases of a single species as the representative of each subgenus, which thus became the type both by monotypy and (practically) by original designation. All of the twenty new subgenera except four contain only a single species each. Of his twenty-seven subgenera the names of seven (*Leo*, *Tigris*, *Panthera*, *Uncia*, *Puma*, *Lynx*, *Felis*) date from previous authors. One (*Otocolobus*) is preoccupied. Two (*Oncoides* = *Leopardus* Gray s.s., *Urolynx* = *Caracal* Gray) are antedated by other names for the same groups. Two (*Profelis*, *Chrysailurus*) are synonymous, having been based (according to Pocock) on the same species under different names. One other (*Catolynx*) appears to have been based on the domestic cat (Pocock) and is thus a synonym of *Felis* (s.s.). *Dendrailurus* was based on an unidentifiable species and is consequently invalid.

Of the twenty new subgeneric groups proposed by Severtzow fourteen have recently been accepted as valid genera, mostly within the present decade. Nine of his groups now recognized as full genera have

¹Notice sur la classification multisériale des Carnivores, spécialement des Félidés, et les études de zoologie générale que s'y rattachent. Par M. N. Severtzow (de Woronéje, sur le Don, Russie. Rev. et Mag. de Zool., (2) IX, 1857, pp. 387-391, 433-439; X, 1858, pp. 3-8, 145-150, 192-199, 241-246, 385-393. The last section (pp. 385-393), containing "la classification des Chats" and a summary of his conclusions regarding "la classification multisériale de la distribution géographique des animaux," was published September 1858, from which all his new genera and subgenera take their date of publication. This noteworthy paper further indicates the author's appreciation of the zonal distribution of life in accordance with geographic conditions, as latitude and elevation, and has on this account, as well as nomenclaturally, considerable historic interest.

²"Je réserve pour ma monographie ou un prodrome spécial la caractéristique de ces genres et sous-genres" (*loc. cit.*, X, p. 390).

³"Voici la classification géographique des Chats; les divisions principales sont nommées d'après "espèce supérieure" (*loc. cit.*, X, p. 395).

been renamed by later authors who either ignored or were ignorant of Severtzow's work, resulting in the addition of sixteen generic synonyms to the nomenclature of the Felidæ, and also indicating that in these instances subsequent authors recognized the groups in question which Severtzow was the first to segregate. Only one valid generic group (*Neofelis* Gray, 1867) has been added.

Severtzow's geographical and nonsystematic method of introducing his new subgenera renders it difficult to gather at a glance their real significance. The following schedule is intended to show more clearly their essential basis and status. His formal list (*loc. cit.*, p. 390) is purely nominal, consisting merely of the names of his genera and subgenera, which to be understood must be correlated with the text of pages 385 to 390.

Severtzow's new subgenera of cats were first brought to the general attention of systematists by Palmer in 1904 in his 'Index Generum Mammalium,' where all are duly entered, although previous notice had been taken of some of them; while Pocock, in his 'The Classification of existing Felidæ' (*Ann. Mag. Nat. Hist.*, (8) XX, pp. 329-350, Nov. 1917), considers them all, adopting eleven of them as full genera (nine of them under Severtzow's names) and allocating the remainder in his synonymies.

In the following annotated list of Severtzow's genera and subgenera, those that appear also in Pocock's recent classification of the existing Felidæ¹ as valid genera are indicated by an asterisk (*) where both the name and the group are the same, and by a dagger (†) when the group is the same but the name different.

I. Genus **TIGRIS**. (Subgenera, 2.)

- 1., ***Leo** = *Leo* Oken, 1816. Type, by tautonymy, *Felis leo* Linné.
2. ***Tigris** = *Tigris* Oken, 1816. Type, by tautonymy, *Felis tigris* Linné.

¹The Classification of existing Felidæ. By R. I. Pocock. *Ann. Mag. Nat. Hist.*, (8) XX, pp. 329-350, Nov. 1917. The names *Leo*, *Tigris*, *Uncia*, *Jaguaris*, are not included in this paper, but are treated in an earlier paper by Pocock (*Ann. Mag. Nat. Hist.*, (8) XVIII, pp. 314-316, Sept. 1916) in which he makes the following statement: "Nevertheless, since the tendency of modern systematic mammalogy has found in the present instance expression in the admission of many species of leopard, lion, jaguar, and tiger, it is possible, perhaps probable, that the logical outcome of that process—namely the ascription of generic rank to each of these animals—will be followed in the future. If that be so, nominal symbols are available for them," which he proceeds to indicate. It is on this basis that these four names are listed below as having been accepted by Pocock.

II. Genus **PANTHERA**. (Subgenera, 4.)

3. ***Jaguaris**. Type, by monotypy, *Felis onca* Linné.
4. ***Panthera** = *Panthera* Oken, 1816. Includes several species, among them *Felis pardus* Linné, the type of the genus.
5. ***Uncia** = *Uncia* Gray, 1854. Type, by tautonymy. *Felis uncia* Schreber.
6. ***Puma** = *Puma* Jardine, 1843. Type, by tautonymy, *Felis concolor* Linné (= *Felis puma* Molina).

III. Genus **CYNAILURUS**. (No subgenera.)

7. †**Cynailurus** = *Cynailurus* Wagler, 1830. Antedated by *Acinonyx* Brookes, 1828. (See Hollister, Bull. 99, U. S. Nat. Mus., 1918, p. 150, footnote.)

IV. Genus **LYNCHUS**. (Subgenera, 2.)

8. †**Lynchus** = *Lynx* Kerr, 1792 = *Lynceus* Gray, 1821 = *Lynchus* Jardine, 1834. Type, by tautonymy, *Felis lynx* Linné.
9. **Urolynchus** = *Caracal* Gray, 1843. Type, *Felis caracal* Schreber.

V. Genus **FELIS**. (Subgenera, 18.)

10. †**Oncoides**. Type, by subsequent designation (Allen, 1905, Pocock, 1917), *Felis pardalis* Linné = *Leopardus* Gray, 1842, with type, by subsequent designation (Pocock, 1906), *Felis pardalis* Linné.

Oncoides was proposed for the small spotted cats of America, explicitly for (1) *Felis pardalis* Linné, (2) *Felis macroura* Wied (= *Felis wiedii* Schinz), (3) *Felis tigrina* Schreber. Gray in 1867 divided Severtzow's *Oncoides* into *Pardalis* and *Margay* (as sections or subgenera of *Felis*), thus rendering the type of *Pardalis*, by tautonymy, *Felis pardalis* Linné. The type of *Margay* is *Felis wiedii* Schinz, by subsequent designation (Allen, 1916, Pocock, 1917). At the same time Gray so restricted his genus *Leopardus* that it contained none of the original species, which were four in number, two of them from Central America and two from British India, he transferring it to the leopards of the Old World and the pumas and jaguars of America. By inadvertence I designated in 1905¹ *Felis leopardus* Schreber

¹Rep. Princeton University Exped. to Patagonia, III, part 1, 1905, p. 167, footnote.

as the type of *Leopardus*, taking the genus as reconstituted in 1843 and 1867, for the moment overlooking the 1842 date of its original publication. On a subsequent page (*loc. cit.*, p. 178) the correct citation is given but without designation of a type. I also designated in the same publication (*loc. cit.*, p. 179), *Felis pardalis* Linné as type of *Oncoides*. In reality the proper name for this group should have been *Pardalis*, as this name was established by tautonymy thirty-five years before a type was correctly designated for either *Leopardus* or *Oncoides*.

11. ***Pardofelis.** Type, by monotypy, *Felis marmorata* Martin.
12. **Catopuma.** Type, by monotypy, *Felis moormensis* Hodgson = *Felis temmincki* Vigors and Horsfield. Synonym of *Profelis*, apud Pocock.
13. ***Herpailurus.** Type, by monotypy, *Felis yaguarundi* Lacépède. *F. eyra*, also mentioned, is a color phase of *yaguarundi*.
14. ***Leptailurus.** Type, by monotypy, *Felis serval* Schreber.
15. **Crysailurus.** Type, by monotypy, *Felis neglecta* Gray = *Felis celidogaster* Temminck.
Chrysailurus is also synonymized by Pocock with *Profelis* Severtzow (type *F. celidogaster*) the latter having page precedence, but in the formal list *Chrysailurus* is No. 15 and *Profelis* No. 21.

16. †**Catolynx**, with 3 species. Type, by subsequent designation (Pocock, 1917), *Felis catus* Linné, the first species mentioned. Hence *Catolynx* = *Felis*, s.s.

17. †**Otocolobus.** Type, by monotypy, *Felis manul* Pallas
 Preoccupied by *Otocolobus* Brandt, 1844, for a genus of Spermophiles. *Manul* is suggested by Severtzow as a preferable name but he did not adopt it. *Otocolobus* was replaced in 1905 by *Trichailurus* Satunin, with the same type by original designation. Hence, *Otocolobus* = *Trichailurus*.

18. †**Lynchailurus.** Type, by monotypy, *Felis pajeros* Desmarest.
 In 1905 (*loc. cit.*, p. 183) I adopted *Lynchailurus* for the *F. pajeros* group and figured the skull and dentition of *L. pajeros crucina*. In 1917 Pocock (*loc. cit.*, p. 348) synonymized *Lynchailurus* with *Dendrailurus* Severtzow (type, by monotypy,

Felis colocolo Hamilton Smith = *Felis strigilata* Wagner, not *Felis colocolo* Molina). I adopted *Lynchailurus* twelve years before Pocock synonymized it with *Dendrailurus*, which fact might have given it preference, notwithstanding the latter has one line precedence over the former.¹ Besides this, the type and only species of *Dendrailurus* "*Felis strigilata*, Wagner (= Colomlo, F. Cuv.)" is unidentifiable, the *Felis strigilata* Wagner, ex *Felis colocolo* Ham. Smith (not of Molina), it having nothing whatever to do (except in the works of various compilers) with the *Felis colocolo* of Molina. It is merely a traditional and thus far an unidentified species. Consequently *Dendrailurus* is invalid.

19. **Oncifelis.** Type, by monotypy, *Felis geoffroyi* Gervais.

Synonymized by Pocock with *Herpailurus*, the type of which is the eyra-yaguarondi cats, a group cranially and externally very different from Gervais's *Felis geoffroyi*. I have on several different occasions in the last few years given generic recognition to *Oncifelis*. Respecting these two groups Pocock himself devotes a long paragraph to the consideration of their differences, beginning: "*H. yaguarondi* and *H. geoffroyi* are widely divergent species in cranial characters, the former departing the most, the latter the least, from the typical feline type. . . ." (*loc. cit.*, 1917, p. 347).

20. **Noctifelis.** Type, by monotypy, *Felis guigna* Molina.

Noctifelis is also synonymized by Pocock with *Herpailurus*. This is contrary to my view of the case, as for several years past, or as soon as a good series of the type species of *Noctifelis* came into my hands (eight specimens, skins and skulls) from near Tumeco, Chili, I have used the name *Noctifelis* on museum labels. This Chilean cat is one of the smallest of the American Felidae, and in coloration and other external characters has little resemblance to any other. The skull is less than half the size of the skull of *Herpailurus*, and resembles it only in a general way.

21. ***Profelis.** Type, by monotypy, *Felis celidogaster* Temminck = *Felis aurata* Temminck.

¹Pocock says (*loc. cit.*, p. 333): "In the choice of names I have been guided strictly by priority, so far as it could be ascertained; and in the case of names proposed by Severtzow line-priority has been taken as the determining factor in the selection."

According to Pocock, as noted above (under No. 15), *Proelis* and *Chrysailurus* have the same type, and on the basis of page precedence he gives preference to *Profelis*, of which he regards *Chrysailurus* as a synonym.

22. **Dendrailurus*. Type, by monotypy, *Felis strigilata* Wagner
As shown above (under No. 18), *Dendrailurus* is unavailable, the validity of the species on which it was based having never been established.

23. **Felis*. Type, by monotypy, *Felis minuta* Temminck. Preoccupied by *Felis* Linné s.s.

24. **Prionailurus*. Type, by monotypy, *Felis pardachrous* Hodgson = *Felis bengalensis* Kerr.

25. **Zibethailurus*. Type, by monotypy, *Felis viverrina* Bennett.

26. **Ictailurus*. Type, by monotypy, *Felis planiceps* Vigors and Horsfield. Antedated by *Ailurin* Gervais, 1855, with same type, if *Ailurin* can be accepted as a tenable name.

27. *Otailurus*. Type, by monotypy, "*Felis megalotis* Sol. Müll. . . . A Timor, un seul Chat, *F. megalotis*" (Severtzow, p. 388).

Pocock says (*loc. cit.*, p. 333), "type *megalotis*, Müll. (domestic cat from Timor)." Jentink, in 1891 (Notes from the Leyden Museum, XIII, pp. 219-220) published a special note on "*Felis megalotis* S. Müller," in which he says: "Again a very rare species, only known from the type-specimen in the Leyden Museum, described in the work entitled 'Verhandelingen over de Natuurlijke Geschiedenis der Nederlandsche Overzeesche Bezittingen, Zoologie, p. 54, 1839-44.' I am not aware that any traveller or naturalist has seen the species or has brought a specimen. The type is a not adult specimen from Timor. . . . The other day I received a collection of animals collected by Dr. H. ten Kate in Timor, and among other mammals he sent over a nearly full-grown male-specimen of *Felis megalotis* in spirits. . . . Dr. ten Kate wrote to me that it seems to be a very rare animal. . . . I think that now a second specimen from the same island has been brought over, nobody will doubt whether *Felis megalotis* really is a *Felis*-species from Timor."



**Article VII.—NOTES ON THE SYNONYMY AND NOMEN-
CLATURE OF THE SMALLER SPOTTED CATS OF
TROPICAL AMERICA**

By J. A. ALLEN

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INTRODUCTION

In the preparation of the preceding paper on Severtzow's Classification of the Felidæ it was necessary to examine all of the available material representing the smaller cats of Tropical America. Unfortunately they are still scantily represented in museums, although the number of specimens has somewhat increased in recent years, notably in some of the museums of this country. The present notes are based on a reëxamination of the specimens in The American Museum of Natural History and on those in the United States National Museum at Washington, which, through the kindness of Mr. Gerritt S. Miller, Curator of Mammals, have been kindly loaned to me for study. I am also indebted to Dr. Witmer Stone, of The Academy of Natural Sciences of Philadelphia, for the loan of the type specimen of *Felis braccata* Cope. Eight specimens have been received for examination from the Carnegie Museum of Pittsburgh, through Mr. W. E. Clyde Todd, from important localities not otherwise represented. The number of specimens, about 150, has been too small, however, for more than a tentative reconnaissance.

Pocock's 'The Classification of Existing Felidæ,' published in 'The Annals and Magazine of Natural History' in November 1917 (ser. 8, XX, pp. 329-350), was the chief incentive to the present investigation, since his classification of the South American species did not coincide with my impressions of their relationships based on previous study, particularly with regard to his genus *Herpailurus* (*loc. cit.*, p. 346), which covers a number of widely diverse groups. As Severtzow's paper on the Felidæ, published in 1858, is so fundamentally associated with the nomenclature of this family it seemed desirable as a first step to present a collation of the names employed by these two authors, resulting in the article presented above (pp. 335-340). The purpose of the present paper is to give a list of the currently recognized forms (species and subspecies) of the smaller cats of Tropical America (therefore excluding the pumas and jaguars), arranged in groups according to their obvious alliances. These groups are given, tentatively and for convenience, the nomenclatural rank of genera. Their evaluation by future investigators will be subject to personal equation, from the viewpoint of whether all cats should be placed in *Felis*, because they are neither bears nor wolves, or that a few leading types may be segregated, to show that the domestic pussy is neither a lion, nor quite a leopard, nor a lynx, or whether it is better to indicate that even among the smaller cats there is some diver-

sity of structure and relationship. To illustrate, the latest faunal list of North American Felidae includes 41 forms, of which 16 are placed in the genus *Lynx* and 25 in the genus *Felis*. Of course the merest tyro in natural history will see at a glance that a part are lynxes and the rest are "cats," but only a specialist in cat nomenclature will be able to recognize which are big cats (as pumas and jaguars) or small cats, or which are plain-colored and which are elaborately patterned with spots and bands, or what are their natural relationships, except in the case of subspecies where the trinomial is the key. A further use of generic divisions would not obscure the fact that they are all cats but would indicate that at least all cats are not alike, and perhaps inspire an interest as to how they differ.

As there is at present a dearth of good illustrations, conveniently accessible, of the cranial characters of the smaller American cats, it has seemed desirable to place before the student comparative figures of the skulls of each of the groups here given generic rank, regardless of the taxonomic value the future may assign to them.

As the result of recent explorations in Central and South America by The American Museum of Natural History it is possible to add to the previous knowledge of a hitherto little-known species (*Felis guigna* Molina), long since recorded from Chili, and of others more recently recorded from Argentina and southern Brazil. Photography has been utilized to indicate, in a few instances, variations in color pattern.

Special attention has been given to questions of nomenclature, which in certain cases have been presented with considerable detail, on account of their general bearing and peculiar interest. The cranial illustrations are from pen-drawings by Mrs. Ziska. The preparation of photographic illustrations was made under the supervision of Mr. Lang, Assistant Curator of Mammals.

The number of forms recognized in the present paper is 37, of which 7 are rated as species and 26 as subspecies, referred to 7 superspecific groups. The one hundred or more specimens examined include the types or practically topotypic specimens of about two-thirds of these thirty-seven forms. Doubtless many regional forms are as yet unrecorded, since vast regions of South America are practically unknown as regards their Felidae, and will so remain until systematic exploration with special reference to securing these elusive beasts has brought together a hundred-fold more specimens than are now available for their intensive study.

LEOPARDUS

Leopardus GRAY, Ann. Mag. Nat. Hist., (1) X, p. 260, Dec. 1842. Not *Leopardus* GRAY, 1867. Type, by subsequent designation (Pocock, 1906), *Felis pardalis* Linné.

Oncoides SEVERTZOW, Rev. et Mag. de Zool., (2) X, pp. 386, 390, Sept. 1858. Type, by subsequent designation (Allen, 1905; Pocock, 1917), *Felis pardalis* Linné.

Pardalis GRAY, Proc. Zool. Soc. London, 1867, p. 270. Type, by tautonymy, *Felis pardalis* Linné.

As noted in the preceding paper, it may be questioned whether *Pardalis* Gray should not have been given preference over *Leopardus* Gray for the larger ocelots. Although the latter has twenty-five years priority of publication, its type was not fixed and the status of the genus was not determined till seventy-five years later. In the meantime *Pardalis* was established (in 1867), the type being automatically (by tautonymy) the species designated in 1906 as type of *Leopardus*. In view of the fact that such ruling would result in the seeming absurdity of rendering *Leopardus* a synonym of a much later established genus, *Leopardus* is here given preference.

1. *Leopardus pardalis pardalis* (Linné)

Felis pardalis LINNÉ, Syst. Nat., ed. 10, I, 1758, p. 42. Type locality, "Mexico," here more definitely assigned as State of Vera Cruz. Originally based on the *Catopardus Mexicanus* of Hernandez.

The large, strongly colored ocelot of southeastern Mexico.

2. *Leopardus pardalis griffithii* (J. B. Fischer)

Felis griffithii J. B. FISCHER, Synop. Mamm. Addend., Emend. et Index, 1830 p. 369 (= 569) = *Felis ocelot* GRIFFITH, Anim. Kingd., V, 1827, p. 433, No. 17 = Ocelot No. 3, Ham. Smith (ined.), idem, II, p. 476, and Pl. (animal) facing p. 169. "A young female of this is now in Mr. Bullock's Mexican collection. It came from Mexico." Ham. Smith, idem, II, p. 477.

Felis canescens SWAINSON, Anim. in Menageries, 1838, p. 120, fig. 17. Based on "Ocelot No. 3" of Ham. Smith. Hence, = *Felis griffithii* Fischer.

Felis albescens PUCHERAN, in Geoffroy, Voy. de la Venus, Zool., 1855, p. 149. Based on a specimen from Arkansas.

Felis pardalis albescens ALLEN, Bull. Amer. Mus. Nat. Hist., XXII, pp. 219-221, July 19, 1906. Escuinapa, Sinaloa. Individual variation and measurements, based on a series of 24 specimens.

Felis limitis MEARNS, Proc. Biolog. Soc. Washington, XIV, p. 145, Aug. 9, 1901; Proc. U. S. Nat. Mus., XXV, 1902, pp. 237, 241-244. Type locality, Brownsville, Texas. To replace *albescens* Pucheran, considered by Mearns to be untenable.

Felis pardalis limitis BAILEY, N. Amer. Fauna, No. 25, p. 66, Oct. 24, 1905. Texas.

In 1902 the late Dr. Mearns, in his paper on the ocelots,¹ wrongly considered *Felis albescens* Pucheran as a synonym of *Felis brasiliensis* F. Cuvier, although Pucheran, in referring the Arkansas specimen provisionally to *Felis brasiliensis*, had such grave doubts of its proper reference to the Brazilian animal that he decided to substitute for it the name *Felis albescens*, which he said would serve to recall its light or whitish coloration, he thus giving validity to the name *albescens*. Mearns proposed the name *limitis* to replace *albescens*, designating Brownsville, Texas, as the type locality of *limitis*. In 1906 I adopted *albescens* for the subspecific designation of the pale form of northwestern Mexico, on the basis of a large series from Escuinapa, Sinaloa, finding that "specimens from Brownsville, Texas, . . . Arizona and Chihuahua" did not differ "essentially from the Escuinapa series."

The correct name for the pale form of northern Mexico appears to be *griffithii* of J. B. Fischer, given in 1830 to Hamilton Smith's "Ocelot No. 3," based on a pale specimen in "Bullock's Mexican collection . . . from Mexico," on which Swainson's name *canescens* was based in 1838. In case the Rio Grande form should prove separable the proper name for it is *albescens*, while *griffithii* would apply to the form of northern Mexico.

3. *Leopardus pardalis mearnsi* (Allen)

Figures 1 to 3, 12a.

Felis costaricensis MEARNS, PROC. U. S. NAT. MUS., XXV, p. 245, Sept. 17, 1902. Type locality, Talamanca, Costa Rica. Not *Felis bangsi costaricensis* Merriam, 1901.

Felis mearnsi ALLEN, Bull. Amer. Mus. Nat. Hist., XX, p. 71, Feb. 29, 1904. Substitute name for *costaricensis* Mearns, preoccupied.

Felis pardalis mearnsi ALLEN, Bull. Amer. Mus. Nat. Hist., XXVIII, p. 108, April 30, 1910. Rio Coco and Pena Blanca, Nicaragua (eastern slope of the highlands).

A large dark form, based on a series of seven specimens. Darker and larger than *L. pardalis pardalis*. Basilar length of three male skulls, 134, 128, 127 mm.; of two female skulls, 117, 112 mm. (Mearns, *loc. cit.*, p. 249), as against 103–118 for ten adult male and 96–102 for three adult female skulls from Escuinapa; zygomatic breadth, same specimens, 108, 99, 96 (males), 92, 92 (females), as against 81–94 (males) and 82–85 (females) from Escuinapa.

Two names had been given to ocelots of the *pardalis* group from Central America previous to Mearns's description of his *Felis costaricensis*; but they prove very difficult to identify and have thus far been held in abeyance. They are *Leopardus griseus* and *L. pictus* of Gray, de-

¹The Ocelot Cats. By Edgar A. Mearns, Major and Surgeon, U. S. A., Proc. U. S. Nat. Mus., XXV, pp. 237–249, Sept. 17, 1902.

scribed in 1842 (Ann. Mag. Nat. Hist., X, p. 260). The first is said to have come from Guatemala, the other from Central America. They seem quite different from Mearns's species from Talamanca, Costa Rica, being differently colored and also much smaller. They were currently treated as synonyms of *Felis pardalis* before the group was divided into species.

4. *Leopardus pardalis sanctæmartæ* (Allen)

Felis sanctæmartæ ALLEN, Bull. Amer. Mus. Nat. Hist., XX, p. 332, Oct. 8, 1904. Type locality, Bonda, Santa Marta, Colombia.

Coast region of northern Colombia (Santa Marta) and northern Venezuela (Pueblo Nuevo, Bolivar Railway).

5. *Leopardus pardalis maripensis* (Allen)

Felis maripensis ALLEN, Bull. Amer. Mus. Nat. Hist., XX, p. 331, Oct. 8, 1904. Type locality, Maripa, Caura district, Venezuela.

A large dark form known only from the type. Basilar length of the skull, 121 mm.; zygomatic breadth, 90 mm.

6. *Leopardus pardalis tumatumari* (Allen)

Figure 19

Oncoides pardalis tumatumari ALLEN, Bull. Amer. Mus. Nat. Hist., XXXIV, p. 632, Dec. 30, 1915. Type locality, Tumatumari, British Guiana.

Felis chibigouazou MEARN'S (not Griffith), Proc. U. S. Nat. Mus., XXV, pp. 246, 249, Sept. 17, 1902. Part; only the redescription based on a specimen from Surinam (not on a specimen from Chapada, Brazil, as stated on p. 239, *loc. cit.*); not the citations.

Felis pardalis ocelot OSGOOD, Field Museum Nat. Hist., Zool. Ser., X, p. 212 Oct. 31, 1916. Santarem, Brazil.

A dark large form, the dark markings intense black and sharply defined, and the ground color tawny. Basilar length of the type skull (male), 139 mm.; zygomatic breadth, 97.5. Next in size to the Costa Rican *L. p. mearnsi*. The Guianas and northeastern Brazil. The specimen here figured (Fig. 19) is the one recorded by Osgood (*loc. cit.*) as *Felis pardalis ocelot*.

7. *Leopardus pardalis æquatorialis* (Mearns)

Felis æquatorialis MEARN'S, Proc. U. S. Nat. Mus., XXV, p. 246, 1902. Type locality, Paramba, northwestern Ecuador.

Oncoides pardalis æquatorialis ALLEN, Bull. Amer. Mus. Nat. Hist., XXXV, p. 222, May 31, 1916. Rio Cauca and Caquetá districts of Colombia.

Similar in size and general coloration to *L. p. mearnsi* of Costa Rica.

8. *Leopardus pardalis pusæa* (Thomas)

Felis pardalis pusæa THOMAS, Ann. Mag. Nat. Hist., (8) XIII, p. 347, March 1914. Chongon, coast region of Ecuador, 15 miles west of Guayaquil.

A small pale form of the southern coast region of Ecuador. Condylbasal length of skull, ♂ 121, ♀ 119; zygomatic breadth, 81, 80.

9. *Leopardus pardalis chibigouazou* (Griffith)

Figures 14 to 18

[Felis] chibigouazou GRIFFITH, Anim. Kingd., V. 1827, p. 167; II, fig. of animal, Pl. facing p. 475 (ex Hamilton Smith MSS.). Cites "Ocelot No. 1, Hamilton Smith, MSS.," and "Chibigouazou, d'Azara Quad. du Paraguay, II, 152."

Felis chibiguazu J. B. FISCHER, Synop. Mamm., Addend., 1830, p. 368 (= 368). Entirely from Griffith, including citation of Azara.

Felis chibigouazou MEARNS, Proc. U. S. Nat. Mus., XXV, 1902, pp. 237, 238, 246, 249. Part; not the redescription from a Surinam specimen (No. 13005, ♂, U. S. Nat. Mus.; cf. last column but one of table of measurements, *loc. cit.*, p. 249).¹ Range given (p. 237) as, "Inhabits Brasil and the northeastern part of South America."

Oncoides pardalis chibigouazou ALLEN, Bull. Amer. Mus. Nat. Hist., XXXV, p. 580, Aug. 9, 1916. Curumbá, Matto Grosso, Brazil.

Felis hamiltonii J. B. FISCHER, Synop. Mamm., Addend., 1830, p. 368 (= 368) = *Felis ocelot* ♂, or No. 2, Hamilton Smith MSS. "South America."

Felis maracaya WAGNER, Schreber's Säuget., Suppl., II, 1841, p. 492. Ostensibly a new name for "*Felis pardalis* Pr. Neuw. Beiträg., II, p. 361." Cites in addition, Chibigouazou, Azara, Essai, I, p. 152, and Rengger's Paraguay, p. 191, from whom the measurements are taken and most of the description; gives the "Heimath" as Northern Patagonia, through Paraguay and Brazil.

A light colored form (ground color usually light buff to pale ochraceous) of Paraguay and Matto Grosso. Its primary basis is the Chibigouazou of Azara, as implied by its specific name and as shown by the primary references of Griffith and subsequent authors to Azara. Hamilton Smith, in his inedited notes in Griffith's 'Animal Kingdom' (II, p. 476) states that of his four Ocelots, "Both No. 1 and No. 2 are from South America." He adds: "I am inclined to think one (or both) of these (if varieties) must be the Chibigouazou of Azara." There is no extant type and no more definite type locality than "South America."

¹There is an unfortunate misstatement in Mearns's paper in regard to the locality of the specimen from which he took his redescription of Griffith's *Felis chibigouazou*. On page 239 he says it was "from Chapada, Brasil, with which Smith's plate figure and description closely agree." On page 237, in his "key to the American Ocelots," he gives the range of *F. chibigouazou* Griffith as "Brasil and the northeastern portion of South America." In his description of the species on page 246 he makes no reference to the specimen (or specimens) he used further than (under "skull and teeth") a cross-reference to his table of cranial measurements, which is on page 249. In this table (column two from the right) the only specimen under *Felis chibigouazou* is "No. 15005, Surinam, South America." It was on the basis of his statement on page 239 that I said in 1916 (Bull. Amer. Mus. Nat. Hist., XXXV, p. 580): "His [Mearns's] description is based on a specimen from Chapada, Matto Grosso, not far from where the present series [referring to those then in hand] was collected, and near the region (Paraguay) of Azara's Chibigouazou." As, however, the Surinam specimen is the only one explicitly mentioned as representing this species it must be inferred that the reference to "Chapada, Brasil" on page 239 is a lapsus and one easily misleading to the reader.

The *Felis* Ocelot of Smith and Griffith

Hamilton Smith, in his inedited notes and drawings in Griffith's *Animal Kingdom*, Volume IV, 1827, pp. 475-480, with facing but unnumbered plates, was the first author to bring confusion into the history of the American Ocelots, of which he figured five, only one of which (*Felis catenata*) he formally named, designating the others numerically as Ocelots Nos. 1-4, and the drawings relating to them in a corresponding manner. Previously the group had been known collectively as *Felis pardalis* Linné. Smith, in the opening paragraph of his notes (which are distinguished by enclosure in marks of quotation), says: "My present view of the Ocelots is that they form a subordinate group in the great family of the Felinæ. . . . They belong all to the New World, but there are two or three species of the Old that approach them in several particulars, and therefore might make the next group. I shall refer in the following descriptions to my drawings numerically. My appropriation of their types to species hitherto described, must, in our present state of knowledge, be conditional only." The next paragraph begins, "*Felis* Ocelot, No. 1," followed by twenty lines giving a description of its coloration, without reference to its size or any other feature, or to its relationships. Then follows "No. 2," (not otherwise designated), with a description six lines long, to which are added remarks referring to both No. 1 and No. 2: "These," he says, "are both from South America. I have examined several of them alive, and about twelve in a stuffed form. I incline to think that one (or both) of these (if varieties) must be the Chibigouazou of Azara. . . . I believe Nos. 1 and 2 to be South American, and Nos. 3 and 4 Mexican, though I do not mean to assert that each may not be found in the country of the other; and if this be so, Azara's appellative seems likely to belong to the former" (i.e., Nos. 1 and 2).

Descriptions of No. 3 and No. 4 follow in due sequence. Of No. 3 he says: "A young female of this is now in Mr. Bullock's Mexican collection. It came from Mexico. I have examined five or six specimens, and believe I have sufficient grounds for considering the differences between this and the preceding [Nos. 1 and 2] not to arise from nonage." Of No. 4 he says: "The specimen figured was formerly in Bullock's collection, supposed to belong to southern Mexico, Honduras, etc." He then refers collectively to Nos. 1-4: "Whether these few are specifically different or hereditary varieties, I do not mean to determine; but from the number of specimens of each that have fallen under my observation, there seems little doubt that one or the other of these

alternatives is correct, and that the several figures are not mere individual differences." The figures (drawings) are engraved separately as plates and are legended "Ocelot No. 1 [to 4] of Hamilton Smith."

The account of the *Felis catenata* follows, and begins: "The *F. catenata* is an undoubted species, of the size of a Wild Cat." Following the description he adds: "Of this I have observed two specimens, one in Bullock's former collection, the other in the Museum at Berlin, which I examined with Professor Lichtenstein, and which proving by the teeth to be an old specimen, convinced him of the reality of its being a distinct species, and not a young Ocelot as he had previously conjectured." It is accordingly not numbered and bears the plate legend "*Felis catenata* Hamilton Smith," with the vernacular name "The Linked Ocelot," supplied perhaps by Griffith. The species has never been confirmed, although often quoted and the figure copied by compilers.

Smith's inedited notes and drawings end with his account of a cat from the interior of Guiana which he thought might be the *Felis colocolo* of Molina. But this forms a subject apart from the ocelots and is treated below in connection with the real *Felis colocolo* Molina (pp. 371-373).

From the foregoing it will be seen that if Smith's "Felis Ocelot" (not in italic type as are his *Felis catenata* and other technical names of cats in his notes) is taken seriously it can only be construed as a synonym of *Felis pardalis* Linné, which Smith does not mention, all his four ocelots being placed under Felis Ocelot, equivalent to *Felis pardalis* as then currently recognized. Griffith, however, in Volume V of his 'Animal Kingdom,' which has the same date as Volume II, seems to have used the name in a more formal or technical way for Smith's Nos. 2 and 3, Smith's No. 4 being synonymized by him with *Felis pardalis* Linné. No. 1 is named, in due form, *Felis chibigouazou*. The other two are listed and numbered as species under *Felis* as follows: "16. *F. ocelot*, β ," with, as a cross-reference "*Felis Ocelot* β , or No. 2, Hamilton Smith Mss." as a synonym; "17. *F. ocelot* γ ," with, as a cross-reference, "*Felis Ocelot* γ , or No. 3, Hamilton Smith." Hence Griffith's Nos. 16 and 17 have a nomenclatural status to be reckoned with.

Three years later, J. B. Fischer, in his 'Synopsis Mammalium' (1830), pp. 568-569 [368-369], renamed "*Felis ocelot* β Griffith" as "*Felis hamiltonii*," and "*Felis ocelot* γ Griffith" he also renamed *Felis griffithii*. Therefore Mearns was quite wrong when in 1902 (*loc. cit.*, p. 239) he restricted "*Felis ocelot* Smith" to "Ocelot No. 2" by "elimination," he being unaware that all of Smith's four ocelots had been named as early as 1830, leaving no opportunity for the application of the principle of

elimination to the case. Fischer followed Griffith in assigning Smith's Ocelot No. 4 to *Felis pardalis* Linné, and his Ocelot No. 1 to *Felis chibigouazou* Griffith. Only Nos. 2 and 3 are left for further consideration. If either or both are satisfactorily identifiable there is still little chance for the resuscitation of the *Felis ocelot* of Smith and Griffith, as neither are recognizable from Smith's descriptions and figures, and neither has a definite type locality, No. 2 being supposed to be South American while No. 3 is stated to have come from Mexico, and thus may be referable to either *pardalis* (s.s.) or to *griffithii*. In view of the known wide range of purely individual variation in pattern of markings—the only character here available—it is evident that no assignment of these names to a regional form can be made except by arbitrary determination, which of course if so made would be open to challenge. As evidence of this, attention is called to the photographic illustrations given below of individual variation in the tone of the ground color and in pattern of markings in series of ocelots from localities in Matto Grosso, Brazil, which could doubtless be duplicated in a large series of specimens from many other localities.

So much space would not be here given to a discussion of the long discredited ocelots of Smith and Griffith, except for Mearns's invalid assignment¹ of "*Felis ocelot* Smith," and its subsequent acceptance.²

Unidentifiable Forms Apparently Referable to *Leopardus*

In the Ocelots, as in most other groups of the Felidæ, and of many other groups as well, many unidentifiable names were given by various writers of the eighteenth and first half of the nineteenth centuries, which, owing to inadequate descriptions, prove the bane of subsequent more critical revisionists. In many cases this is due not wholly to lack of detail in the descriptions, or to the poor quality of the accompanying illustrations, but to lack of information as to the geographical sources from which their material was derived. This was often wholly unknown

¹The points apropos of Mearns's assignment of the name *Felis ocelot* Smith are here presented synoptically:

	Mearns, 1902	Fischer, 1830
	Ocelot No. 1 = <i>Felis chibigouazou</i> Griffith, 1827.	= <i>Felis chibiguazu</i> Fischer ex Griffith.
" <i>Felis ocelot</i> Smith"	Ocelot No. 2 = <i>Felis ocelot</i> Mearns ex Smith.	= <i>Felis hamiltonii</i> Fischer.
	Ocelot No. 3 = <i>Felis canescens</i> Swainson, 1838.	= <i>Felis griffithii</i> Fischer.
	Ocelot No. 4 = <i>Felis pardalis</i> Mearns, ex Griffith.	= <i>Felis pardalis</i> Fischer ex Griffith.

²Field Mus. Nat. Hist., Zool. Ser., X, p. 212, Oct. 31, 1916. Type locality designated as Guiana. Smith's figure of his Ocelot No. 2, however, has very little resemblance to the ocelot of Guiana (my *Leopardus pardalis tumatumari*), much less indeed than his Ocelot No. 1, referred by Griffith and later authors to Azara's Chibigouazou.

to them, or if known was not stated, or stated in too general terms, and thus is inadequate to meet modern requirements. The case of Hamilton Smith and his ocelots is only an illustration of a prevailing condition. Descriptions and illustrations based on menagerie specimens, either living or dead, from unknown localities, and seldom preserved as types, prove an inherited curse rather than an aid in modern research.

Among the unidentifiable names given to the *pardalis* group in addition to *Felis ocelot* Smith and Griffith and *Felis catenata* H. Smith (1827), are *Felis mitis* F. Cuvier (1820), *Felis brasiliensis* F. Cuvier (1828, name preoccupied), *F. armillata* F. Cuvier (1832), *Felis pseudo-pardalis* Boitard (1842), *Felis melanura* Ball (1844, no locality nor measurements), *Felis pardalis minimus* Wilson (1860, Realejo, Nicaragua, but "too young to eat anything except milk"), *Felis pardoides* Gray (1867), *Panthera ludoviciana* and *P. jardinii* Fitzinger (1869), and others.

Individual Variation in the Color Characters of Ocelots

Figures 14 to 18.

A series of eight specimens—flat skins (hunters' pelts, of which only two have skulls)—collected by George K. Cherrie in 1917 at Descalvados on the Paraguay River about 300 miles north of Curumbá, in Matto Grosso, well illustrates the wide range of individual variation in color in ocelots. The color patterns of five of these specimens are shown below in Figures 14 to 18 (pp. 402-406); the other three are variously intermediate in ground color and markings between the five that are figured, no two of the series being alike. The ground color varies in the different specimens from deep ochraceous buff to pale buff. This feature is indicated to only a slight degree in the photographic reproductions by the depth of tone. The pattern of coloration, however, is sharply defined and permits of comparison of details in the markings of the different specimens. As regards the ground color, it is deepest in the specimen represented in Fig. 14, less deep in Fig. 15, but much deeper in this than in either of the other three. In the specimens shown in Figs. 16 and 17, the ground color is practically the same, while the one shown in Fig. 18, represents the extreme of paleness for the series. In regard to the color patterns, attention is called to the variation in the size or areas of the black markings in comparison with the extent of the intervening ground color, the extremes being represented in Figs. 1 and 5. Also the diversity presented in the nape bands, the shoulder markings, and in the median dorsal stripes.

Fig. 19 is introduced to illustrate the contrast between the light phase of southern Brazil and the dark form of the Lower Amazon and the Guianas, in which the ground color is tawny and the dark markings are intense black.

A series of flat skins (hunters' pelts) from Curumbá, received from the Roosevelt South American Expedition, completely parallels the series of eight already described in tone of ground color and character of markings. The ground color ranges from pale buff to ochraceous buff, and the markings are equally variable in extent in comparison with the intervening areas of ground color and in pattern. A smaller proportion, however, have the median dorsal line solid black.

In these Matto Grosso specimens, as is the rule in ocelots generally, the ground color from the crown to a little behind the withers is of a deeper tone than that of the posterior half of the dorsal area. Similarly the median third of the dorsal area is of a much deeper tone than the lateral third on either side of the central area.

MARGAY GRAY

Margay GRAY, Cat. Carniv., Pachyderm., and Edentate Mamm. Brit. Mus., 1869, p. 21. "Smaller, small-headed, spotted American Cats." Type, by subsequent designation (Allen 1916, Pocock 1917), *Felis wiedii* Schinz.

Margay ALLEN, Bull. Amer. Mus. Nat. Hist., XXXV, p. 550, footnote, Aug. 8, 1916. *Felis macroura* Wied (= *Felis wiedii* Schinz) designated as type.

Oncoides SEVERTZOW, Rev. et Mag. de Zool., (2) X, pp. 386, 390, Sept. 1858. Part; *Felis macroura* Wied and its near allies only.

Leopardus POCOCK, Ann. Mag. Nat. Hist., (8) XX, p. 344, Nov. 1917. Part; *Felis wiedii* and its allies only.

While Pocock (*loc. cit.*, p. 345) includes the smaller spotted American cats in *Leopardus* he recognizes that they form a group quite different from the true ocelots. He says: "In addition to the true ocelots, often called jaguars, I refer to this genus *L. wiedii* (*macroura*), commonly cited as *tigrina*, which may be described as a small, long-tailed, smooth-skulled representative of the ocelots. The skull is like that of a young ocelot in most respects, showing at most a shallow postorbital constriction, with the temporal crests forming a lyriiform area generally wide but varying in width with age and possibly locally. The skulls differ, however, from those of ocelots in having a tolerably regular rounded low occipital area; even when the occipital crest is well developed its edges have no definite lateral emargination; and the inferior edge of the orbit is thin, with the preorbital thickening hardly developed." These are some of the differences that distinguish the two groups, but there are

others of equal or greater importance, among which are the general contour of the skull and the proportionate development of different regions. In a comparison of skulls of the two groups, particularly those of old males, the first thing to attract attention is the small size and weak structure of the skull in the *wiedii* group in contrast with that of the *pardalis* group, that of the former being much less than half the size of the latter. In *wiedii* the dorsal contour is evenly convex from the nasal to the occipital border, with neither sagittal nor lambdoid crests, which are highly developed in *pardalis*; the brain-case is broad and short, its point of greatest elevation being at the frontoparietal suture instead of inter-orbital; the orbits are very large, the axial diameter about 32 per cent of the occipitonasal length of the skull against less than 25 per cent in *pardalis*, and they are often closed posteriorly in *wiedii* and broadly open in *pardalis*; the postorbital constriction is slight or nil in *wiedii*, well developed in *pardalis*; in *wiedii* the postorbital processes are weak but long and slender, often meeting and sometimes coalescing with the process of the malar in *wiedii*, heavy and short in *pardalis*, leaving the middle third of the posterior border of the orbit open; in *wiedii* the zygomata are narrow and weak, in *pardalis* broad and heavy; in *wiedii* the dental armature is weak, in *pardalis* heavy, in agreement with the weak general structure of the skull in *wiedii* and its heavy ossification in *pardalis*. The following comparative cranial measurements, based respectively on an average old male skull of *Leopardus pardalis griffithii* from Sinaloa, Mexico, and an old male skull of *Margay tigrina wiedii* from southern Matto Grosso, Brazil, indicate some of the proportional differences between the skulls of *Leopardus* and *Margay*. Total length, *griffithii* 144 mm., *wiedii* 91 (ratio, *griffithii* being 100, 63.4); condylobasal length, 135, 84 (ratio 62.2); zygomatic breadth, 99.5, 61.3 (ratio 62.5); breadth at postorbital constriction, 38, 31.5 (ratio 83); tip to tip of postorbital processes, 55, 52 (ratio 94.5); greatest width of brain-case, 54, 42 (ratio 77.7); upper toothrow (c-m), 44.3, 27.5 (ratio 62.1).

Young skulls of the *pardalis* group before the strong crests have formed are not so strikingly different, except in size, from the skull of the *wiedii* forms. The general appearance of the skull in the *pardalis* forms changes greatly with age after the animal has reached maturity. In the *wiedii* forms, on the other hand, mainly owing to the non-development of crests, the general aspect of the skull changes little with age, having acquired its mature form and nearly its mature size by the time the permanent teeth are fully developed.

In 1903 Thomas published¹ some very suggestive observations on the smaller spotted American cats, in which he formally recognized three "types" or groups, and suggested two others as follows:

"I. Size larger. Fur soft and thick. Nape-hairs generally reversed forwards, at least in part." Typified by "*Felis wiedii* Schinz (*F. macroura* Wied), and many others, including *F. glaucula* sp. n."

"II. Size rather smaller. Fur harsher. Nape-hairs not reversed. General colour darker. Skull long and narrow, somewhat resembling that of the Jaguarondi, with narrow braincase and elongated face." Typified by *Felis guttula* Hensel.

"III. Size smallest. Fur medium or harsh. Nape-hairs not reversed. Skull small and delicate, with smooth braincase and elongated." Typified by "*Felis pardinoides* Gray (*F. guigna* Molina of Hensel)."

"In addition," Thomas continues, "the small-spotted *F. geoffroyi*, with its little ally *F. salinarum*, sp. n., makes yet a fourth Neotropical section of the group; while a fifth appears to be formed by the true *F. tigrina*, judging by a small cat from Cayenne which may be assigned to that species, and is distinguished by its small size, bright colouring, and delicate skull; but it is in too imperfect a state for me to describe it more fully." (Thomas, *loc. cit.*, pp. 234-235.)

The genus *Margay* Gray, as here restricted, comprises the *Felis tigrina* (including *F. wiedii*) and *Felis glaucula* groups, characterized by reversed nape-hairs, large size, and a highly arched brain-case, and is equivalent to Thomas's "type I" and his tentative "type fifth."² The range of the *Margay* group extends from Espirito Santo and Matto Grosso, Brazil, to Jalisco, Mexico.

Thomas's types II and III, of which *Felis guttula* Hensel and *Felis pardinoides* Gray are respectively designated by Thomas as representative, are tentatively united to form a single group of at least subgeneric value, which for convenience is here treated as a full genus. No existing name being available for the group, the designation *Oncilla* is here provided, with *Felis pardinoides oncilla* Thomas as type. The distribution of this group appears to coincide very nearly with that of *Margay*. The skull of *Oncilla*, in its smoothness and weak structure, resembles

¹ 'The Spotted Tiger-cats of Brazil,' in 'Notes on Neotropical Mammals of the Genera *Felis*, *Hapale*, *Oryzomys*, *Akodon*, and *Ctenomys*, with Descriptions of New Species.' By Oldfield Thomas. Ann. Mag. Nat. Hist., (7) XII, pp. 234-243, Aug. 1903.

² Thomas says that "a fifth [type] appears to be formed by the true *F. tigrina* [Schreber], judging by a small cat from Cayenne which may be assigned to that species. . . . Apropos of this I may state that there is a skull in the collection of the American Museum labeled as from Cayenne, purchased for the Museum many years ago by D. G. Elliot as a part of the Verreaux Collection, that is indistinguishable from skulls I have identified as *Felis wiedii* or from other skulls of the *wiedii* type from the Santa Marta and Caqueta districts of Colombia.

that of *Margay*, but the dorsal outline is less convex and the brain-case less expanded. It is also much narrower in proportion to its length; the postorbital processes, though slender, are much shorter, and the auditory bullæ are less inflated, and relatively much smaller and narrower. The nape-hairs are not reversed; the coloration is often much darker, but the color pattern is not essentially different.

Felis geoffroyi, Thomas's fourth type, may well be kept separate, for which Severtzow's *Oncifelis* is available, while *Felis parjeros* and its subspecies are also kept separate as *Lynchailurus* Severtzow. The hitherto little-known *Felis guigna* Molina, although nearly related to *Oncilla* in cranial characters, may be referred to *Noctifelis* Severtzow, on the basis of external differences, and forms its only representative.

The three groups, *Margay*, *Oncilla*, and *Noctifelis* are closely related and differ markedly from *Leopardus* on the one hand and from *Oncifelis* on the other. In case they should be regarded as only subgenerically separable, the oldest name for the combined group is *Noctifelis* Severtzow, with *Noctifelis* s. s., *Margay*, and *Oncilla* as subgenera.

The number of local forms of *Margay* and *Oncilla* and their geographical relationships cannot now be determined, as they are poorly represented in museums. In order to satisfactorily settle these questions a large amount of material will have to be brought together, comprising large series of specimens from many localities. Hence it will doubtless be many years before such conditions will be realized. The early described forms are, as usual, extremely difficult to determine, the descriptions being too vague to be distinctive, and usually based on specimens from undesigned or wrongly designated localities.

1. *Margay tigrina tigrina* (Schreber)

Felis tigrina SCHREBER, Säug., III, Pl. cvi, 1775, text, p. 396, 1777 (= *Le Margay* BUFFON, Hist. Nat., XIII, 1765, pp. 248-253, Pl. xxxvii).

Based on Buffon's description and figure of a specimen from Cayenne. Probably ranges into eastern Venezuela and northern Brazil.

2. *Margay tigrina wiedii* (Schinz)

Figures 4a, 6a, 9a, 12a

Felis wiedii SCHINZ, Thierreich, I, 1821, p. 235. Based on specimens in the Wied Coll. from Brazil.

Felis macroura WIED, Beitr. Naturg. Brasilian, II, 1826, pp. 371-379; Abild., Lief. 3, plate and text without numeration. Southeastern Brazil = *F. wiedii* Schinz, based on the same specimens.

Felis macrura HENSEL, Abhandl. Akad. Berlin, 1872, p. 71. Rio Grande do Sul, Brazil.

Margay tigrina wiedii ALLEN, Bull. Amer. Mus. Nat. Hist., XXXV, p. 580 and footnote, Aug. 9, 1916. Part; only the specimen from Florencia. Type locality of *wiedii* determined as northern Espirito Santo, Brazil.

Southern Brazil, west to southern Colombia. Its range is at present very imperfectly known.

3. *Margay tigrina vigens* (Thomas)

Felis wiedii vigens THOMAS, Ann. Mag. Nat. Hist., (7) XIV, p. 192, Sept. 1904. Igarapé-Assu, near Para, Brazil.

Range unknown. Described from a single specimen. The cranial measurements agree closely with a skull from Cayenne, including the large size of the bullæ.

4. *Margay glaucula glaucula* (Thomas)

Felis glaucula THOMAS, Ann. Mag. Nat. Hist., (7) XII, p. 235, Aug. 1903. Beltram, Jalisco, Mexico.

A large form characterized by the paleness of the ground color, "grey instead of fulvous or tawny." "This grey Mexican representative of the *F. wiedii* group contrasts markedly in color with the tawny forms found to the south of it from Costa Rica to S. Brazil." Other specimens are also referred to it from "Tatemales, Sinaloa, and N. Yucatan." Skull of type: greatest length 94.5, basal length 82, zygomatic breadth 63, tip to tip of postorbital processes 49. I have examined specimens from Yucatan (Nat. Mus.), Cordoba and Los Masos, Mexico (Amer. Mus.).

5. *Margay glaucula nicaraguæ*, new subspecies

Type, No. 28957, ♂ ad., Volcan de Chinandego, Nicaragua, August 20, 1908; W. B. Richardson.

Similar in general color pattern to *M. glaucula glaucula* but much more richly colored and apparently larger.

Ground color of upperparts fulvous instead of "pale drab gray"; black markings narrow, linear, sharply defined, occasionally enclosing patches of the ground color, arranged on the thighs in transverse rows of large oval blotches, on the shoulders in vertical bands; whole underparts and inside of limbs pure white, the chin, throat, and abdominal region unspotted, the pectoral area with narrow linear stripes of black, and a broad black throat band. Differs from a specimen of typical *glaucula* from Los Masos, Jalisco, Mexico, chiefly in its much richer, more fulvous coloration.

Collector's measurements of the type in the flesh: total length, 1260 mm.; head and body, 750; tail vertebrae, 510; hind foot (from skin), 116. Skull: total length, 107; basal length, 93; condylobasal length, 100.9; zygomatic breadth, 72.2; nasals on middle line, 18.7; interorbital breadth, 19.2; tip to tip of postorbital pro-

cesses, 51.6; interorbital constriction, 32.3; breadth of brain-case, 43; palatal length (from notch to anterior base of incisors), 40.5; length of bulla, 20.8; length of p⁴, 12.4.

An adult female from Matagalpa, Nicaragua, is also referred to this subspecies, which resembles the type in all essentials except that it is just appreciably lighter in coloration and slightly smaller. It is however much more richly colored and decidedly larger than either an adult male from the type region of *glaucula*, or than the type of *glaucula* as indicated by the description. Total length, 970; head and body, 580; tail, 390; hind foot (from skin), 110. Skull: condylobasal length, 89; zygomatic breadth, 65.8; interorbital breadth, 16.9; tip to tip of postorbital processes, 52.5; postorbital constriction, 35.2; length of bulla, 19.7; breadth of brain-case, 47.5; length of p⁴, 11.3.

ONCILLA, new genus

Type, *Felis pardinoides oncilla* Thomas.

Skull without crests, smooth and of weak structure, as in *Margay*, but with dorsal outline much less convex and frontal area flatter, brain-case narrower, skull narrower in proportion to its length, postorbital processes slender and short, auditory bullae less inflated and narrower in proportion to their length. Nape-hairs normal instead of reversed, pelage soft and full, color sometimes richer and darker but color pattern nearly the same as in *Margay*.

1. *Oncilla pardinoides pardinoides* (Gray)

Felis pardinoides GRAY, Proc. Zool. Soc. London, 1867, p. 400; Cat. Carniv., Pachyd. and Edentate Mamm. Br. Mus., 1869, p. 27. "Hab. India (Capt. Innes: from Zool. Soc. Mus.)."

Felis pardinoides GRAY, Ann. Mag. Nat. Hist., (4) XIII, 1874, pp. 51-52. "I will not undertake to vouch for the accuracy of the habitats we receive from the Zoological Society; the Indian habitat has not been confirmed; and the species has a very South-American aspect."

Felis pardinoides GRAY, idem, p. 475, June 1874. "The British Museum has received, from Mr. Edward Gerrard, a cat from Bogotá that I have no doubt is the same species as the typical specimen of *Felis pardinoides*. . . ."

Felis pardinoides ELLIOT, Proc. Zool. Soc. London, 1872, p. 203; Monog. Felidae, 1883, Pl. xx, lower figure. Confidently refers *Felis pardinoides* Gray to *Felis Geoffroyi* D'Orbigny and Gervais, as an immature specimen of the latter.

Felis guigna HENSEL, Abhandl. Akad. Berlin, 1872, p. 74. Rio Grande do Sul. Part; not the melanistic specimen from Chili.

Felis pardinoides THOMAS, Ann. Mag. Nat. Hist., (7) XII, pp. 236-237, Aug. 1903. Redescribed from Espiritu Santo specimens. No reference is made to Gray's previous designation of Bogotá as the type locality of his *Felis pardinoides*. (Cf. above, the citation of Gray at June 1874.)

Southeastern Brazil (Espiritu Santo and Rio Grande do Sul), apud Thomas.

Dimensions of male as given by Thomas: "Head and body 500 mm.; tail 255; [=total length 755]; hind foot 105; ear 38. Skull: greatest length 83; basal length 71.5; zygomatic breadth 49.5; nasals, length in middle line 16.5; . . . interorbital breadth 14.2; tip to tip of postorbital processes 32; intertemporal breadth 25; . . . breadth of braincase 38; length of bulla 17; . . . length of p^4 on outer edge 9.6."

2. *Oncilla pardinoides oncilla* (Thomas)

1. *Felis pardinoides oncilla* THOMAS, Ann. Mag. Nat. Hist., (7) XII, p. 237, Aug. 1903. Based on a skin from Volcan de Irazu, Costa Rica.

Felis carrikeri ALLEN, Bull. Amer. Mus. Nat. Hist., XX, p. 47, Feb. 29, 1904. Pozo Azul, Pirris Province, Costa Rica. Apparently a melanism of *O. pardinoides oncilla* (Thomas). I have before me a similar melanism of *O. pardinoides emerita* from Merida, Venezuela.

Known only from Costa Rica.

3. *Oncilla pardinoides andina* (Thomas)

Felis pardinoides andina THOMAS, Ann. Mag. Nat. Hist., (7) XII, p. 238, Aug. 1903. Jima, Province of Azuay, Ecuador. Altitude 2400 m.

Felis pardinoides andina Lönnberg, Ark. för Zoologi, VIII, No. 16, p. 6, July 12, 1913. Ahunchi, below Malchinqui, and north side of Mt. Pichincha, at altitudes of 10,000 to 11,000 ft.

Known only from the Andes of Ecuador.¹

Type, total length 810, "head and body 520, tail 290, hind foot 109, ear 41. Skull, greatest length 86, basal length 73.5, zygomatic breadth 53.5, breadth of braincase 41."

4. *Oncilla pardinoides emerita* (Thomas)

Figures 4b, 8b, 9b, 12c

Felis pardinoides emerita THOMAS, Ann. Mag. Nat. Hist., (8) X, p. 44, July 1912. Montes de la Cutala, Merida, Venezuela.

Margay tigrina wiedi ALLEN, Bull. Amer. Mus. Nat. Hist., XXXV, p. 223, May 31, 1916. Part; the Andalusia specimen only.

Margay tigrina emerita ALLEN, Bull. Amer. Mus. Nat. Hist., XXXV, p. 582 (footnote), Aug. 9, 1916. Record of a specimen (practically a topotype) from Merida, Venezuela.

Merida, Venezuela, and southward in the Eastern Andes to Huila, Colombia.

Type: total length 810 mm.; "head and body 480, tail 380, hind foot 98. Skull: greatest length 85, condylobasal length 81.3, zygomatic

¹The specimen recorded by me in 1916 (Bull. Amer. Mus. Nat. Hist., XXXV, p. 123), from Loja, Ecuador, alt. 8000 ft., as *Margay wiedi andina* was wrongly identified, it proving to be a *Margay* and not an *Oncilla*.

breadth 5.5 [=55.0], breadth of braincase 40." Feet "scarcely darker below than above" (Thomas, *loc. cit.*).

A skin without skull (from Andalusia, Huila, Colombia, altitude 5000 feet) was referred by me in 1916 (*loc. cit.*) to *Margay tigrina viedi*. The mislaid skull has since been found and shows that the specimen is referable to *Oncilla*, not to *Margay*. Reëxamination of the skin shows that it is a male (not a female as first supposed), and that it agrees in all external characters with a topotype of *emerita*, being as pale (or slightly paler) than this pale form, even to the pale foot-soles. Total length (collector's measurements), 800 mm.; head and body, 380; tail, 420; hind foot (c.u.), 110. Skull: greatest length, 88; condylobasal length, 82.6; zygomatic breadth, 59.3; breadth of brain-case, 41.6.

5. *Oncilla pardinoides elenæ* (Allen)

Margay tigrina elenæ ALLEN, Bull. Amer. Mus. Nat. Hist., XXXIV, p. 63, Dec. 30, 1915. Santa Elena, Antioquia, Colombia. Altitude 9000 feet.

Known only from the type locality. Similar in a general way to *O. p. emerita* (Thomas), from Merida, Venezuela, with topotypes of which it has been compared.

6. *Oncilla caucensis* (Allen)

Margay caucensis ALLEN, Bull. Amer. Mus. Nat. Hist., XXXIV, p. 631, Dec. 30, 1915. Las Pavas, near San Antonio, Upper Rio Cauca, Colombia. Based on a skin, but the skull (imperfect, preorbital region and mandible only preserved) has since been found.

Known only from the type. Characterized by the deep fulvous ground color of the upperparts, lighter fulvous underparts, and sharply defined, intensely black markings.

7. *Oncilla guttula guttula* (Hensel)

Felis guttula HENSEL, Abhand. Akad. Berlin, 1872, p. 73. Rio Grande do Sul, Brazil.

Range, southern Brazil (Thomas). A specimen from "Parana" and another from Curumbá, Matto Grosso, both hunters' skins without skull, are provisionally referred to this form.

8. *Oncilla guttula emiliæ* (Thomas)

Felis emiliæ THOMAS, Ann. Mag. Nat. Hist., (8) XIII, p. 348, March 1914. Ipu, Ceará, Brazil.

"This striking cat . . . is clearly a representative in the dry country of Ceará of the South Brazilian *F. guttula*" (Thomas, *loc. cit.*).

NOCTIFELIS SEVERTZOW

Noctifelis SEVERTZOW, Rev. et Mag. de Zool., (2) X, pp. 386, 390, Sept. 1858. Type, by monotypy, *Felis guigna* Molina.

Herpailurus Pocock (not of Severtzow), Ann. Mag. Nat. Hist., (8) X, pp. 346, 350, Nov. 1917. Part; *Noctifelis* only.

Noctifelis closely resembles *Oncilla* in cranial characters, but is nearly one-fifth smaller in external measurements, while the cranial measurements are practically the same. It has, however, larger ears, absolutely as well as relatively, and a shorter and more heavily furred tail, so that the tail in *Noctifelis* has the appearance of being short and thick, instead of long and slender as in *Oncilla* and *Margay*. The color pattern in *Oncilla* is essentially the same as in *Margay* and *Leopardus*, the predominating features being heavy black bands extending from the forehead to the mid-dorsal region, and elongated black markings on the shoulders, flanks and thighs. In *Noctifelis* the black markings are reduced to small rounded spots, nowhere coalescing to form well-defined bands. It has the usual cat marks, as the whitish ear-spots and the cheek and throat bands, and in some instances nape-stripes are vestigially present. On the basis of external features *Noctifelis* is here recognized as a natural group, easily distinguishable from *Oncilla*. The type, and apparently the only known species, is the smallest and one of the most distinctively marked of the American small spotted cats. In seven skulls (six adult and one with the milk dentition), p^2 is uniformly absent in all, although present as a rule in all the nearest allied groups.

***Noctifelis guigna* (Molina)**

Figures 4c, 7a, 10a, 12a, 20 to 22

Felis guigna MOLINA, Saggio sulla storia nat. del. Chili, 1782, pp. 295, 341. Forests of Chili.

Felis guigna PÖPPIG, Froriep's Notizen, XXV, No. 1, p. 7, July 1829. Talcahuano, Chili.

Felis guigna PHILIPPI, Arch. f. Naturg., Jahrg. 36, Bd. 1, 1870, pp. 41-43. Very common in Valdivia, Chili. Molina's descriptions of both the Guigna and Colocolo declared to be so sufficiently distinctive that one cannot doubt as to which of the Chilian species they refer (*loc. cit.*, p. 42).

Felis guigna HENSEL, Abhandl. Akad. Wissen. Berlin, 1872, p. 74. Part; only the casual reference to a melanistic specimen from Chili.

Felis guigna PHILIPPI, Arch. f. Naturg., Jahrg. 39, Bd. 1, 1873, pp. 8-12, Pl. II (animal and skull). Very abundant in the Province of Valdivia.

Felis guigna THOMAS, Ann. Mag. Nat. Hist., (7) XII, p. 240 (in text), Aug. 1903. Type locality given as Valdivia, Chili, on the basis of Philippi, as above cited.

Molina's brief account of this small cat proved a stumbling block to all succeeding systematists for nearly a century, when in 1870-1873,

Philippi¹ cleared up the mystery through first-hand knowledge of the species and its habitat.² After transcribing Molina's account in full, he comments on the fact that its internal evidence gave proof that Molina had seen these two cats (the Guigna and Colocolo) and that his descriptions of them were so good that one could not doubt as to which of the Chilian species they applied. He adds that *Felis guigna* was still very common in the Province of Valdivia, and refers to stuffed specimens in the museum at Santiago on which the fuller account in his second paper is based.

The earlier compilers recorded it as a little-known species, often of doubtful validity; later it was sometimes synonymized with various earlier described forms, while other systematists were convinced that it was founded on an immature specimen of *Felis geoffroyi*.

As stated above *Felis guigna* Molina was first given a recognized basis by Philippi, who in 1873 gave a fairly good description of its external and cranial characters and figured the animal and the skull. The latter unfortunately was immature and imperfect, lacking the occipital part. This led to a misinterpretation of the case on the part of some later authors, who construed Philippi's *Felis guigna* as a young example of *Felis geoffroyi*. In the light of the series of specimens now available for study, however, it is evident that this inference was erroneous, and that the animal described by Philippi as the *Felis guigna* of Molina is a species remarkably distinct from any other known. Thomas (*loc. cit.*), on the basis of Philippi's paper, was justified in designating Valdivia as its type locality.

Philippi, in commenting on its abundance near Valdivia, says that it sometimes visited the outskirts of the city to steal fowls and meat. He relates that he had been informed it sometimes appeared in small bands ("schaarenweis"), and that on one occasion about twenty of them were killed in a single morning. He also states that it is often melanistic, wholly black examples being of frequent occurrence. Of four specimens in the museum at Valdivia he states that two were of the light-colored spotted phase and the other two entirely black. His figure represents

¹Ueber *Felis Colocolo* Molina (und auch *Felis Guigna*). Von Dr. R. A. Philippi in Santiago. Arch. f. Naturg., Jahrg. 36, Bd. 1, pp. 41-45.

Ueber *Felis Guigna* Molina und über die Schädelbildung bei *Felis Pajeros* und *Felis Colocolo*. Von Dr. R. A. Philippi. Arch. f. Naturg., Jahrg. 39, Bd. 1, 1873, pp. 8-15, Pl. II, *Felis Guigna* (animal and skull); Pl. III, Figs. 1, 2, *Felis Colocolo* (skull), Figs. 3, 4, *Felis Pajeros* (skull).

²Pöppig (*loc. cit.*) was unquestionably the first to give a clearly recognizable description of Molina's *Felis guigna*, although his citations ("*Felis Guigna*. Mol.—*Felis tigrina* L. ?") led to misunderstanding by subsequent writers. His diagnosis and detailed description could only have been based on an actual specimen, and his accompanying narrative of his sojourn of some months near Talcahuano render it certain that such was the case. In view of the specimens now available from the same district, it is easy to recognize that his description can relate only to this species.

the spotted phase. So far as I am aware no later report based on actual material has been published.

The present series of eight specimens was collected by D. S. Bullock, an American engineer and an intelligent and painstaking natural history collector, who spent some time near Valdivia in 1910-1911. The specimens comprise seven adults (4 males, 3 females) and a kitten still in first pelage and with the milk teeth. One of the adults lacks the skull, and the brain-case of three others is badly broken but they are available for most of the usual measurements. The labels give full field data and flesh measurements and the native name (written "wiña," probably phonetic for *guña*, the usual vernacular name of the species). They were nearly all taken at Marquhue, Temuco, Province of Cautin, about seventy-five miles north of Valdivia. The series shows considerable variation in color, some being much darker than others, possibly tending toward melanism.

One of lightest specimens of the series has the ground color of the upperparts deep buff, of the underparts clear white. The face markings are as usual in the small spotted cats, but much reduced in extent and distinctness, especially the superciliary lines and the dark bands from the side of the nose to the inner base of the ears, which are rudimentary and inconspicuous. The top of the head, from forehead to nape, is slightly freckled with touches of blackish. Of the usual nape-stripes only the two outer are recognizable as bands, they consisting of only partly coalesced dark brown or blackish spots. Elsewhere on the dorsal and lateral areas are small, solid, scattered blackish spots without any distinct arrangement except along the median dorsal area where they tend to form both axial and transverse rows, and oblique rows on the thighs. The upper surface of the feet is unspotted except for the proximal fourth. The tail is heavily ringed with black dorsally and laterally, a few of the apical bands nearly meeting below. The black annulations are about equal in breadth to the intervening spaces of ground color, and vary in number from 10 to 12, with a blackish tip. The white of the underparts has a broad brownish black cross-band on the throat, a few broken rows of small spots on the foreneck, a few scattered spots on the pectoral area, while large black spots predominate over the white on the thoracic region; the inguinal region and the inside of the thighs are white, the latter varied with more or less transverse rows of black spots. The ventral side of the tail is medially whitish. The soles of the feet are blackish, the tips of the hairs on the proximal part increasingly grayish.

In the darkest specimen the ground color above is of a less buffy

tone, and the dark spots are coarser and blacker, and tend in places to unite into irregular and rather indistinct bands, particularly on the nape and shoulders. The dark tail bands are broader, their width exceeding the interspaces. The dark spots below are larger and more intensely black; on the thighs they form rather heavy transverse bands. A young specimen in the woolly first pelage is marked as in the adults, but the spots are duller and less sharply defined.

The external measurements show that *Noctifelis guigna* is considerably smaller than any of the known forms of *Oncilla*, the average total length for four males being 644 mm., as against 804 for the same number of males of *Oncilla* (representing four subspecies); the corresponding measurements for head and body are respectively 439 and 503; tail and 290; hind foot 96 and 108. The difference in cranial measurements of the same two series is, however, much less, the condylobasal length being respectively 80 and 84 mm., the zygomatic breadth 53.8 and 54.7, and the breadth of the brain-case 39.3 and 39.4.

EXTERNAL MEASUREMENTS OF *Noctifelis guigna* (MOLINA)

CAT. NO.	SEX	LOCALITY	TOTAL LENGTH	HEAD AND BODY	TAIL VERT.	HIND FOOT	EAR
33278	♂	Temuco, Chili	650	420	230	90	40
33283	♂	Temuco, Chili	648	418	230	100	46
33284	♂	Temuco, Chili	660	440	220	100	46
33286	♂	Temuco, Chili	700	480	220	96	43
33285	♀	Temuco, Chili	605	395	210	87	40
33287	♀	Temuco, Chili	640	390	250	94	40
33288	♀	Temuco, Chili	645	450	195	95	38
Average	4 ♂ ♂		644	439	225	96	44
Average	3 ♀ ♀		630	412	215	89	39

MEASUREMENTS OF SKULLS OF *Noctifelis guigna* (Molina)

(Same Specimens as in the Preceding Table)

CAT. No.	SEX	TOTAL LENGTH	CONDYLO-BASAL LENGTH	PALATAL LENGTH	ZYGOMATIC BREADTH	INTER-ORBITAL BREADTH	POST-ORBITAL PROCESSES	POST-ORBITAL CONSTRICTION	BREADTH OF BRAIN-CASE	AUD. BULLÆ	UPPER TOOTH-ROW C-M ¹	LENGTH OF I ⁴
33283	♂	83.5	80.5	31.6	53.7	14.7	38.2	28.0	39.8	16.4×11.2	26.1	9.5
33284	♂	85.8	79.1	31.2	52.2	13.9	32.5	23.0	39.8	17.5×11.7	25.0	9.5
33286	♂		80.0	30.9	56.3	15.1	.....	.....	.....	17.0×11.8	24.4	9.2
33288	♂		77.9	29.5	53.1	15.7	37.5	25.0	.....	17.8×11.1	23.8	9.7
33285	♀	79.2	73.7	28.4	51.1	15.6	.....	25.5	38.8	16.2×11.2	22.8	9.1
Average 4 ♂♂			79.3	30.8	53.8	15.2	36.2	27.8	.....	17.2×11.5	24.3	9.2

ONCIFELIS SEVERTZOW

Oncifelis SEVERTZOW, Rev. et Mag. de Zool., (2) X, pp. 386, 390, Sept. 1853. Type, by monotypy, *Felis geoffroyi* D'Orbigny and Gervais.

Herpailurus Pocock, Ann. Mag. Nat. Hist., (8) XX p. 346, Nov. 1907. Par—t; the *Oncifelis geoffroyi* group only.

The skull of *Oncifelis* is heavily ossified, the frontal region high and broad, the brain-case long and narrow, rostrum deep and broad, sagittal and lambdoid crests well developed in adults, and the dentition heavy. In certain features it resembles the skull of *Herpailurus*, differing from it greatly in others, as in the structure of the preorbital and palatal portions and in its much heavier dentition. Most of these differences have been noted by Pocock (*loc. cit.*, p. 347), who says: "*H. yaguarondi* and *F. geoffroyi* are widely divergent species in cranial characters, the former departing the most, the latter the least from the typical feline type." He might have added that this is also true in respect to their external characters, the general form being slender in *yaguarondi* and heavy in *geoffroyi*, the color in the former unspotted and in the latter profusely spotted, with a conspicuously annulated tail. He finally adds: "On account of the differences in the skulls the two species might be regarded as generically or subgenerically distinct, but the difficulties of definition would in that case be great on account of *H. pardinoides* and its allies occupying in many cranial respects an intermediate position between the two. . . ." This statement seems to betray a misapprehension of the characters of the *Felis pardinoides* group, here recognized as a special group, of at least subgeneric value, under the name *Oncilla*.

Felis salinarum Thomas is here associated with *geoffroyi* in the genus *Oncifelis*, but the two species are by no means closely related, *salinarum* being a much smaller species, with a much weaker skull and dentition. Both are spotted cats, with long and conspicuously ringed tails, but the details of coloration are quite different in the two forms. The *Felis colocolo* group is unrepresented in the material I have been able to examine, but judging from the literature, including Philippi's figures of the skull, it seems referable to *Oncifelis*, but the color characters do not indicate a close relationship with *geoffroyi*.

1. *Oncifelis geoffroyi* (D'Orbigny and Gervais)

Figures 5a, 7b, 10b, 13a, 23

Felis geoffroyi D'ORBIGNY AND GERVAIS, Bull. Soc. Philom. Paris, 1844, p. 40; Mag. de Zool., 1844, Mamm., Pl. LVII (animal); Voy. d'Amér. Merid., 1847, p. 21, Pl. XIII (skull), Pl. XIV (animal). Rio Negro, Patagonia.

- Felis (Oncifelis) geoffroyi* SEVERTZOW, Rev. et Mag. de Zool., (2) X, 1858, p. 386.
- Felis (Oncoides) geoffroyi* LAHILLE, Congr. cient. Lat. Amer., III, 1899, p. 178.
- Oncoides geoffroyi* ALLEN, Rep. Princeton Univ. Exped. Patagonia, III, part I, Mamm. Southern Patagonia, pp. 180-183, April 28, 1905. Cañon de las Vacas and mouth of Rio Santa Cruz, southern Patagonia.
- H[erpailurus] geoffroyi* Pocock, Ann. Mag. Nat. Hist., (8) XX, p. 347 (in text), Nov. 1917.
- Pardalina ? guigna* GRAY, Ann. Mag. Nat. Hist., (4) XIII, p. 51, Jan. 1874. Part; ". . . there can be no doubt that *Felis Geoffroyi* of D'Orbigny and Gervais is the same as *F. guigna* of Molina and Philippi."
- Felis geoffroyi* BURMEISTER, Descrip. phys. Répub. Argentine, III, 1879, pp. 124-126. Part; *F. guigna* of Molina considered as only a smaller southern form of *F. geoffroyi*.
- Felis geoffroyi* ELLIOT, Mon. Felidæ, 1883, Pl. xx, Part; not the synonymy, nor the lower figure of the plate, and only part of the description.
- Felis guigna* MIVART, The Cat, 1881, p. 410. Not *Felis guigna* Molina.
- Felis guigna* LYDEKKER, Handbook of Carnivora, 1895, p. 149. Part; only the more southern and eastern "race, *Felis geoffroyi* of the Argentine"
- Pardalina warwickii* GRAY, Proc. Zool. Soc. London, 1867, p. 267, fig. 4 (skull), p. 405, Pl. xxiv (animal). "*Himalaya* (Warwick). Probably from South America?"
- Pardalina warwickii* SCLATER, Proc. Zool. Soc. London, 1870, p. 796. Identified as *Felis geoffroyi*.

This species was originally described from specimens collected on the Rio Negro, Patagonia, in about latitude 40° south. It appears to range thence southward to the Straits of Magellan, and westward to the eastern base of the Andes, and has been reported from as far north as the Upper Parana. Its range to the northward, as formerly given, seems to have been not clearly distinguished from that of *S. salinarum*.

The few specimens I have seen appear to indicate a considerable range in the tone of the ground color, from nearly clear gray to pale fulvous, which is the tone represented in D'Orbigny and Gervais's figures. One of two specimens collected by Dr. Hrdlička near the type locality in 1910 (Nos. 171953 and 171954, U. S. Nat. Mus.) agrees closely in color with the original figure of the species, while the other is much paler. Gray's figure of his *Pardalina warwickii* (*loc. cit.*, animal) agrees closely in pattern of markings with *geoffroyi* but not in ground color, which is deep cinnamon instead of pale fulvous, and is probably over-colored, as Sclater (*loc. cit.*) unhesitatingly identified the type of *warwickii* with a specimen of *geoffroyi* from Patagonia by direct comparison.

2. *Oncifelis salinarum* (Thomas)

Figures 5b, 8a, 11a, 13b, 24 to 29

?*Felis colocolo* MATSCHIE, Sitzungsab. Gesells. naturf. Freunde Berlin, 1894, p. 60. Puna, near Jujuy, Argentina.

Felis salinarum THOMAS, Ann. Mag. Nat. Hist., (7) XII, p. 239, Aug. 1903. Cruz del Eje, Central Cordova, Argentina. Altitude 600 m.

Felis salinarum is described as "a small northern representative of *F. geoffroyi*." The type was a female of which the following measurements are given: "Head and body 435 mm.; tail 265; [total length 700]; hind foot 97; ear 37. Skull: greatest length 84.5; basal length 71; zygomatic breadth 56.5; length of nasals in midline 17; inter-orbital breadth 15.5; tip to tip of postorbital process 38; postorbital constriction 26.5; breadth of braincase 41.5; palate 32; length of upper incisive row 10; length of p⁴ on outer edge 10.7."

This species is represented by a series of eight specimens collected by Leo E. Miller and H. S. Boyle in southern Bolivia and northern Argentina for The American Museum of Natural History in 1915 and 1916. Four of them are skins, with skulls and field measurements, two of which are adult males, the others an adult female and a young female, the latter with the milk dentition still present. The remaining four are native skins without skulls, designation of sex, or flesh measurements. The two males are from the Province of Sucre at elevations of 8700 and 9400 feet, the adult female is from Tilcara, Santiago del Estero, Province of Jujuy, Argentina, at an altitude of 1800 feet, and the flat skins are from the nearby locality of Lavelle, at the same altitude. They vary in ground color from pale buffy white to rather deep buff; the dark markings are similar in pattern in all but vary somewhat in breadth, being a little coarser or heavier in some than in others. The color pattern is similar to that of *O. geoffroyi* and quite unlike that of *N. guigna*. (See Figs. 20 to 29, pp. 408-417.)

As shown by the tabulated measurements below, this species is much smaller than *geoffroyi*, and much larger than *guigna*. The female are much smaller than the males, and as the adult female of the present series agrees very closely with the measurements given for *salinarum* and as four of the specimens closely agree with the description of the species, the whole series is referred with little hesitation to *salinarum*. On this basis *O. salinarum* appears to range in latitude from about 19° to 31°, and from an elevation of 1800 (central Cordova in Argentina) to above 9500 feet (Province of Sucre in Bolivia). Five of the specimens were taken at a point (Lavelle) only about 240 miles due north of the type locality of *salinarum* and at the same elevation; one at about the same distance still further north, and two (both males) some 300 miles north of the last named point, the total distance in latitude from the type locality northward to the most northerly point represented by the

present series being about 780 miles. A good series of well-prepared specimens from each of the four districts indicated might show noteworthy local differentiation, not revealed by the present small number of specimens, of which one half are merely hunters' pelts. The accompanying photographic illustrations (Figs. 24-29) show a close similarity in color pattern of specimens from points widely separated by latitude and elevation. It is to be noted that the measurements of the type skull (female) agree closely with those of the adult female of the present series, while the external or "flesh measurements" are much smaller.

There is a marked difference in the size of the skull, in ossification, and in the size of the teeth between the large male skull of *salinarum*, which is at least middle-aged or older (all the sutures except the nasal sutures indistinguishable) and the skull of *geoffroyi*, which is apparently much younger (most of the sutures clearly traceable). In *geoffroyi* the frontal region is more elevated, much broader and more heavily ossified, including the postorbital processes, the temporal ridges are nearer together and much more strongly developed, uniting posteriorly to form a crest 5.5 mm. in height, with a corresponding development of the occipital crests, heavy development of the suborbital region, and very heavy dentition. In the old male skull of *salinarum* the temporal ridges are slight (none present in the younger but fully adult male nor in the female), the general structure of the skull is relatively weak, with which the size of the teeth is correlated. In brief, the skull of *salinarum* is a large edition of that of *Oncilla* or *Noctifelis*, while that of *geoffroyi* is a reduced *Leopardus* type. Yet the color pattern of *salinarum* resembles closely that of *geoffroyi* and is not at all the same as that of *Oncilla*, and still less like that of *Noctifelis*. Hence *salinarum* forms a type of at least subgeneric value intermediate between *Noctifelis* and *Oncifelis*. (See the photographic reproductions of color patterns of *Noctifelis guigna*, *Noctifelis geoffroyi* and *O. salinarum*, pp. 408-417.)

EXTERNAL MEASUREMENTS OF *Oncifelis salinarum*

Cat. No.	LOCALITY	DATE	SEX AND AGE	TOTAL LENGTH	HEAD AND BODY	TAIL VERTER.	HIND FOOT	EAR
39004	Rio Cachimayo, Sucre, Bol., 8700 ft.	Dec. 9, 1915	♂	840	440	400	105	55
39010	Pulque, Sucre, Bol., 9400 ft.	Nov. 25, 1915	♂	840	500	340	110	52
41553	Lavelle, Santiago del Estero, 1800 ft.	June 30, 1916	♀	690	430	280	95	50
41551	Lavelle, Santiago del Estero, 1800 ft.	July 9, 1916	♀ juv. ¹	670	420	250	100	50
Type ²	Cruz del Eje, Cordoba, 1800 ft.	Nov. 28, 1901	♀	700	435	265	97	37

¹With milk dentition.

²From Thomas, loc. cit.

CRANIAL MEASUREMENTS OF *Oncifelis salinarum* (Same specimens as in the Preceding Table)

Cat. No.	SEX	GREATEST LENGTH	CONDYLO-BASAL LENGTH	BASAL LENGTH	PALATAL LENGTH	NASALS ON MIDLINE	ZYGOMATIC BREADTH	INTER-ORBITAL BREADTH	POST-ORBITAL PROC.	POST-ORBITAL CONST.	BREADTH OF BRAIN-CASE	UPPER JAW (C-M)	OUTSIDE LENGTH OF P ⁴
39004	♂	90.4	84.8	78.6	34.7	16.8	58.4	16.4	40.8	30.4	42.8	27.8	11.0
39010	♂	90.5	89.0	81.5	53.3	19.2	64.1	17.6	42.5	29.2	44.0	30.0	10.9
41553	♀	84.6	78.4	72.1	30.4	15.4	51.8	13.3	35.6	26.5	41.2	27.8	10.7
41551 ¹	♀ juv.	81.0	73.0	66.8	30.0	12.8	52.3	13.0	30.6	28.2	42.7	19.7	....
Type ²	♀	84.5	.....	71.0	32.0	17.0	56.5	15.5	38.0	26.5	41.5	....	10.7
10408 ²	♂?	107.6	98.3	91.3	41.7	21.0	71.7	20.4	....	28.2	45.6	31.7	13.3

¹With milk dentition; no fully up. crown of p⁴ visible under tricus of dp⁴.

²From Thomas, loc. cit. *Oncifelis salinarum*. Included for comparison with *O. salinarum*.

3. *Oncifelis colocolo* (Molina)

Felis colocolo MOLINA, Saggio sulla storia nat. del Chili, 1782, pp. 295, 341. Forests of Chili.

Felis colocolo PHILIPPI, Arch. f. Naturg., Jahrg. 36, Bd. 1, 1870, pp. 43-45, Pl. I, fig. 7 (animal). Based on a live specimen in the Zoological Garden of Santiago, captured at the Hacienda Dehesa, in a place called Infernillo, in the Cordillera de Santiago, a few leagues from the city of Santiago, late in September, 1869 (*loc. cit.*, p. 44). This locality is now designated as the type locality of the species.

Felis colocolo PHILIPPI, Arch. f. Naturg., Jahrg. 39, Bd. 1, 1873, pp. 11-14, Pl. III, figs. 1, 2 (skull).

Felis colocolo BURMEISTER, Descrip. phys. Répub. Argentina, III, 1879, p. 126. Includes *Felis jacobita* Cornalia as a synonym.

Felis jacobita CORNALIA, Mem. Soc. Italiana di Sci. nat., I, No. 1, 1865, pp. 1-9, Pl. (animal). "Bolivia; circa Potosi et Humacuaca in montibus sat elevatis."

Felis jacobita MATSCHIE, Sitzungsber. Gesells. naturf. Freunde Berlin, 1912, No. 4, p. 258. Regarded as so importantly different from *F. colocolo* that both should stand as distinct "Rassen."

Felis colocolo Elliot, Mon. Felidæ, 1883, Pl. XII (animal). Part; only in so far as it relates to *Felis jacobita* Cornalia, on which the plate and much of the description is based. The plate is an improved copy of Cornalia's, with the attitude altered and the general effect made more artistic.

Felis colocolo Molina, as well as Molina's *Felis guigna*, was first placed on a recognizable basis by Philippi in his papers on these species published (*loc. cit.*) in 1870 and 1873. His description and figure were made from a live specimen in the Santiago Zoological Garden, captured in the Cordillera de Santiago, not far from the city of Santiago, in September, 1869. It is characterized especially by its cross-banded pattern of coloration of the back and sides. While in a general way resembling *Felis pajeros* Desmarest, it is instantly distinguished from it by its very long conspicuously black-ringed tail. The cranial differences are set forth in Philippi's second paper (1873, *loc. cit.*) where the skull is figured and compared in detail with the skull of *F. pajeros*. He unfortunately omits to state whence the skull of either *Felis colocolo* or *F. pajeros* which he described were obtained, but the implication of the context seems to be that they were both of Chilian origin. The source of the living specimen (a young male) of *F. colocolo* which served as the basis of his description and figure of the animal is explicitly stated to be the Cordillera de Santiago, only a few leagues ("wenige Stunde") from the city of Santiago. It seems proper to accept this district as the type locality of the species.

The type of *Felis jacobita* Cornalia was sent to him from Buenos Ayres by Professor Mantegazza. Burmeister states (*loc. cit.*, p. 128): "J'ai vu moi-même à Buenos-Ayres, dans les mains de M. le professeur Mantegazza, l'exemplaire que Cornalia a fait dessiner; il avait été

chassé sur les montagnes au-dessus de Potosi et Hamacuaca en Bolivie." He also states: "L'individu [de *colocolo*] que j'ai examiné, correspond au *Felis jacobina*, dont la description a été prise par Cornalia." He accordingly refers *Felis jacobita* to *Felis colocolo* as a synonym without apparent reservation. A comparison of the figure of *jacobita* with the later published figure of *colocolo* by Philippi (who evidently was ignorant of the existence of Cornalia's paper) shows a striking agreement in the pattern of markings in both, and the descriptions of the coloration are strikingly similar for both, except that Philippi makes no mention of the ventral surface, which Cornalia describes as "maculis ventralibus rubiginosis aut lete fulvis."

Felis colocolo Molina is still very imperfectly known, not more than one or two specimens having apparently reached museums, but it is seemingly very distinct from its nearest allies, which are evidently *Felis geoffroyi* Desmarest and *Felis salinarum* Thomas. Its home, so far as known, is the high plateaus of the Andes in Bolivia and Chili.

The history of *Felis colocolo* Molina was long blended with that of *Felis colocolo* Hamilton Smith, who in 1827 (Griffith's Animal King., II, p. 479 and illustration) described and figured a cat from Guiana which he doubtfully referred to Molina's species. This proceeding gave rise to a new problem without shedding any light on the old one, and to the increase of synonymy, as, despite the geographic improbabilities, Hamilton Smith's description and figure became a part of the history of Molina's *Felis colocolo*, and its range became extended to include Guiana. As Smith's use of the name, however, was provisional his description and figure of the Guiana specimen became in 1838 the *Felis lineata* of Swainson (Anim. in Menag., p. 128), and, in 1861, of the *Felis strigilata* of Wagner (Schreber's Säug., Suppl., II, p. 546), and the Smith *colocolo* still remained an unsolved enigma. Indeed, so good a naturalist as St. George Mivart in 1881 (The Cat, p. 413), included in his chapter on the "different kinds of cats" the *Felis colocolo*, giving its distribution as "Guiana and Chili, and doubtless intermediate countries also." Still later, Richard Lydekker, in his 'A Hand-book to the Carnivora' (1895, pp. 177-179, Pl. XXI) gave new life to the legend of the *colocolo* cat, quoting Hamilton Smith's original picturesque account in full (as good copy for a popular hand-book), and giving its distribution as "north-eastern and western South America, the species being recorded from Guiana and Chili," etc.

*Type, by monotypy, of *Dendrailurus* Severtzow 1858 = *Dendrailurus* Pocock, 1917, invalid because based on an unidentifiable species.

Apropos of the foregoing I cannot resist the temptation to give in full the note by the late John Edward Gray entitled 'On *Felis colocolo*, Hamilton Smith, F. Cuvier, and Geoffroy,' published in 1874 (Ann. Mag. Nat. Hist., (4) XIII, pp. 259-260), since it throws light not only upon the character of this sub-mythical species, but as a revelation of historic interest in connection with the working methods of the artist-naturalist who contributed so largely of both drawings and text to Griffith's 'Animal Kingdom,' and consequently so disastrously and lastingly to the labors of subsequent investigators of the Felidæ, as indicated above in treating of the ocelots. Gray's note gives evidence that it was inspired by no unkind feeling toward his "late friend and teacher, Colonel Hamilton Smith," which fact adds to its interest and value.

Major Hamilton Smith made a figure of an animal "said to have been shot in the interior of Guiana by an officer of Lewenstein's Riflemen, and by him stuffed and sent to England, but which probably never reached its destination." It is represented as a white cat, with various-sized longitudinal brown dashes on its neck and body, with slate-coloured legs and feet, and a slender black tail with numerous white rings.

Of this drawing an account was published in Griffith's 'Animal Kingdom,' in Geoffroy and Cuvier's 'Histoire Naturelle des Mammifères' (where the animal is said to come from Surinam), and in Jardine's 'Naturalist's Library,' iii, p. 256, pl. xxvi, where the legs are erroneously left pale-coloured, though said to be blackish in the description.

I have never seen this cat, and am not aware of its ever having been seen or of its being in any museum in Europe. It certainly is not the *Felis colocolo* of Molina, from Chili, figured by Philippi, Wiegmann's 'Archiv.' 1870 p. 41, t.i. fig. 7, and [1873] t. iii. figs. 1 & 2.

My late friend and teacher, Colonel Hamilton Smith, drew animals most beautifully and with great facility, and made a very large collection of sketches and drawings of them and of antiquities and costumes, which he collected from museums that he visited, and books, and even fragments of skins. Unfortunately, instead of drawing the specimen or the figure of the animal which he examined as it was, he had the habit of improving its attitude, and even of making a beautiful drawing from a bad specimen, or from a fragment of a skin, or from a rough sketch, or from a woodcut or other figure which he found in some old book; and he very often did not mark his drawings whence or how they were obtained; so that it was difficult to tell their authority. He seldom finished or colored his sketches at the time he made them, but would mark on the parts of the drawing with the colour that they ought to be (as "red," "white," "black") without indicating the shade. This explains why the figures which are taken from his sketches in the first volume of Jardine's 'Naturalist's Library' (1842) were so erroneously coloured, and makes the determination of some of his figures doubtful. It was this defect that rendered his beautiful and extensive series of sketches of so little value to the zoological student.

4. *Oncifelis colocolo neumayeri* (Matschie)

Felis (*Lynchailurus*) *colocolo neumayeri* MATSCHIE, Sitzungsber. Gesells. naturf. Freunde Berlin, 1912, p. 259. Rio das Mortes, Matto Grosso, Brazil (Rio Tocantins drainage).

This is a large form of apparently the *colocolo* group, with which it agrees in general style of coloration, but the markings of the upperparts are described as not so distinctly cross-banded, with other differences of coloration. It is based on a skin (at least no skull is mentioned) the measurements of which are given as head and body 850 mm., tail 410, giving a total length of 1260 mm. This, with the geographical conditions, render it difficult to allocate. It is here included merely as a matter of record.

LYNCHAILURUS SEVERTZOW

Lynchailurus SEVERTZOW, Mag. de Zool., (2) X, 1858, pp. 386, 390. Type, by monotypy, *Felis pajeros* Desmarest.

Pajeros GRAY, Proc. Zool. Soc. London, 1867, p. 269. Type, by both monotypy and tautonymy, *Felis pajeros* Desmarest.

Lynchailurus ALLEN, Rep. Princeton Univ. Exped. to Patagonia, III, part I, p. 183, Pl. XXIV (skull), April 28, 1905 = *Lynchailurus* Severtzow.

Dendrailurus Pocock, Ann. Mag. Nat. Hist., (8) XX, pp. 348, 349, Nov. 1917. Type, by monotypy, *Felis colocolo* H. Smith = *Felis strigilata* Wagner, an unidentifiable species. Part; not of Severtzow.

General outlines and proportions of the skull much as in *Oncifelis*, but with differences in several important details, particularly in the size and form of the bullæ, which are not only larger and much more inflated, but have the outer chamber "enormously" (Pocock) enlarged; palatal region and mesopterygoid fossa much broader and the latter shorter; the facial portion of the skull correspondingly wider, and the dentition much weaker, particularly p^3 and p^4 . The color pattern is radically different from that of any of the other spotted American cats in having the tail without annulations, and in other respects in the coarse and rather weakly defined and faintly indicated body and head markings, although retaining many of the distinctively 'cat marks' of the felines. It is further distinguished by the character of the pelage, which is coarse and long, and by the presence of a prominent dorsal crest of lengthened black-tipped hairs, divided by a narrow pale line.

The *Lynchailurus pajeros* group ranges from southern Patagonia to northern Argentina in the pampas, and has been recorded as occurring in Chili, southeastern Peru, and also from the vicinity of Quito, Ecuador.

As already indicated in a preceding paper (supra, p. 338), Pocock

adopted *Dendrailurus* Severtzow for the Pampas cats, but the only species referred to this genus by Severtzow was the mythical *Felis strigilata* Wagner, based on Hamilton Smith's description of a cat from Guiana which he "conditionally" referred to *Felis colocolo* Molina. As Smith's *colocolo* is unidentifiable, the genus *Dendrailurus*, based solely upon it, is invalid and cannot be substituted for *Lynchailurus*, based exclusively on *Felis pajeros* Desmarest.

1. *Lynchailurus pajeros pajeros* (Desmarest)

Le Chat Pampa, AZARA, Essais sur l'Hist. nat. des Quad. de le Paraguay, 1801, pp. 179-184. "Les pampas, au Sud de Buenos-Ayres, entre les pajonals du 35.° et du 36.° degré de latitude."

Felis pajeros DESMAREST, Nouv. Dict. d'Hist. nat., VI, 1816, p. 114. From Azara, as above.

Pajeros pampanus GRAY, Proc. Zool. Soc. London, 1867, p. 269. New name for *Felis pajeros* Desmarest.

Felis passerum SCLATER, List of Vert. Anim., 1872, p. 40. The name *passerum* proposed as a classical substitute for the barbarous *pajeros* of Desmarest.

Felis pajeros PHILIPPI, Arch. f. Naturg., 1873, Bd. 1, pp. 10-15, Pl. III, figs. 1 and 2 (skull). Comparison of the skull structure with that of *Felis geoffroyi* (= *F. colocolo* Philippi, not of Molina nor of Ham. Smith). No localities mentioned for either.

Felis pajeros BURMEISTER, Descrip. phys. Répub. Argentine, III, 1879, pp. 128-130. Part. Found throughout the Province of Buenos-Ayres, but rare more to the northward, but a specimen is recorded from Entre-Rios; not rare in Chili.

The range of the type form of *pajeros* is at present impossible to define. The type locality is about midway the range of the group, with that of *p. crucina* at the southward in Patagonia; recently other forms have been set off at the northward, which are as yet known only from their respective widely separated type localities. It was first made known from the Province of Buenos Ayres by Azara as the Chat Pampa, from specimens he obtained inland from La Plata, in latitude 35° to 36°, from which region it has since been frequently reported, and is said to have formerly been common in Uruguay, but absent from Paraguay.

2. *Lynchailurus pajeros crucina* (Thomas)

Felis pajeros WATERHOUSE, Zool. Voy. Beagle, Mamm., 1839, p. 18, Pl. IX (animal). Santa Cruz, Patagonia.

Felis pajeros crucina THOMAS, Ann. Mag. Nat. Hist., (7) VIII, p. 247, Sept. 1901. Santa Cruz, Patagonia, lat. 50° S. Based on the Santa Cruz specimen described and figured by Waterhouse, as above.

Felis pajeros crucina ALLEN, Rep. Princeton Univ. Exped. to Patagonia, III, part I, 1905, pp. 183-186, Pl. XXIV (skull). Rio Gallegos, Patagonia, lat. 51° S.

A large pale southern form, with the color markings indistinct except on the ventral surface and limbs, and with the dorsal crest strongly developed. Total length, 1070 mm.; head and body, 790; tail, 270. Skull: total length, 108; condylobasal length, 96.8; basal length, 91.7; zygomatic breadth, 78.6.

3. *Lynchailurus pajeros thomasi* (Lönnberg)

Felis pajeros thomasi LÖNNBERG, Ark. för Zoologi, VIII, No. 16, p. 7, Pl. 1 (animal), July 12, 1913. "Shot in a sugar-cane field near Quito, Ecuador."

Color pattern strongly defined; size smaller than in the more southern forms. Total length (male, type), 780 mm.; head and body, 510; tail, 270. Skull: greatest length, 88; condyloincisive length, 82; basal length, 76; zygomatic breadth, 64 (Lönnberg, *loc. cit.*).

Known only from the type, from a quite unexpected locality (Quito, Ecuador) for a member of the *pajeros* group.

4. *Lynchailurus pajeros garleppi* (Matschie)

Felis (Lynchailurus) pajeros garleppi MATSCHIE, Sitzungsab. Gesells. naturf. Freunde Berlin, 1912, No. 4, p. 259. Cusco, Peru.

Felis pajeros garleppi LÖNNBERG, Ark. för Zool., VIII, No. 16, p. 9, July 1913.

According to Lönnberg (*loc. cit.*), *L. p. garleppi* is larger than his *L. p. thomasi*, and has "the blackish spots of the lower side less conspicuous, the reddish spots on the sides smaller and more continuous, the dark cross-bands of the hind legs less sharply developed, but the cross-bands of the forelegs complete and not broken up," etc. He gives measurements of the skull, in comparison with those of *thomasi*, those of *garleppi* being: condyloincisive length, 87 mm.; basal length, 78.3; zygomatic breadth, 66; length of p^4 , 12 (as against 10 in *thomasi*). To Dr. Lönnberg is due the credit of making known the real characters of Matschie's *garleppi*, for which mammalogists should be grateful.

5. *Lynchailurus pajeros braccatus* (Cope)

Figures 30 and 31, type

Felis braccata COPE, Amer. Nat., XXIII, pp. 144-146, Feb. 1889. "Rio Grande do Sul, or in Matto Grosso" (=Chapada, Matto Grosso, Brazil). Skin, without skull.

Cope compared his *Felis braccata* (a skin without skull), with the *Felis yaguarondi* of authors, but so clearly pointing out its differences from that species in color markings and other features as to render it quite evident that his *braccata* was quite unlike any known phase of *yaguarondi*. Whenever it has since been mentioned, however, it has

been associated with the *yaguarondi* group. Feeling sure that the type specimen was in the museum of the Philadelphia Academy of Natural Sciences, I wrote to Dr. Witmer Stone, Curator of Mammals and Birds, requesting that, if practicable, he would kindly have it sent to me for examination. It proved to have been mounted, but nevertheless was duly forwarded. At a glance it was evident that its affinities were not with the *jaguarondis*, and as clearly that it was a member of the *Lynchailurus pajeros* group. The coarse, harsh pelage, the presence of an incipient dorsal crest of lengthened hairs, and the color pattern are as in the *pajeros* group, with the marked difference that the lower part of the limbs and feet are blackish instead of pale buffy gray. The general coloration of the upperparts is somewhat darker, due mainly to the darker tone of the underfur. The oblique and ill-defined bands on the sides are rather stronger and more obvious, as are the cross-bands on the proximal portions of the limbs, throat, and fore-neck, while the spotting of the underparts is better defined and darker. The apical two inches of the tail is black slightly grizzled with gray, in contrast with the more proximal part. The lower portion of the fore limbs, extending upward on the inner side, is brownish black, increasing distally in intensity to dull black on the feet. The hind limbs are similarly darkened. The ground color of the flanks, chin, and whole underparts is faintly yellowish, but the dark spots are not bordered with yellow as is usually the case in typical *pajeros*. The ears externally are black for about the anterior half, the rest of the outer surface being gray, with no distinctly lighter spot.

The dark color of the limbs and the wholly black feet at first suggest a melanistic specimen of the *pajeros* type but careful consideration of the coloration as a whole hardly bears out this impression, and it seems preferable for the present to allow *braccata* to stand as a probable regional form of the *pajeros* group, characterized especially by its dark limbs and feet.

The locality of the type specimen is given by Cope as "the province of Rio Grande do Sul or in Matto Grosso," the collector's label having been lost, and also the skull. The type was collected by Herbert H. Smith on his Chapada, Matto Grosso, expedition in 1882-1886, who, on his way to Chapada landed at Porto Alegre, Rio Grande do Sul, passing through this province in a northwesterly direction to the Uruguay River, stopping en route for several months at São João do Monte Negro in about latitude 28°, where he made collections which included, according to Cope's synopsis (*loc. cit.*, pp. 148-150), 26 species of mammals. In

the synopsis *Felis braccata* is placed in the Chapada list, and only *Felis geoffroyi*, of the cats, is credited to São João.

On Mr. Smith's return to the United States his collections of birds and insects were placed in storage at The American Museum of Natural History, his mammals and reptiles having been delivered direct to the late Professor E. D. Cope of Philadelphia, as per contract. Later his bird collection and duplicate mammals were purchased by this Museum. The latter numbered about eighty specimens, and were chiefly skulls and skeletons, representing about fifteen species. Among the five cat skulls is one (Amer. Mus. No. 354) that I have never been able to identify until now. It proves to be a *Lynchailurus*, but is so much smaller than the only other skull of this group I have been able to examine (an old male skull of *L. pajeros crucina* from southern Patagonia) that its relationship to this form was overlooked. It now proves, beyond reasonable doubt, to be the type skull of Cope's *Felis braccata*. It fortunately has still attached to it the collector's original label bearing the following legend: "No. 3. Gato Merrisco. Chapada, Matto Grosso, Nov. 1884." The skull is fully adult, and an examination of the skin shows that the specimen was a male. It differs mainly from the above-mentioned skull from southern Patagonia (about S. lat. 50°) in its much smaller size. It has, however, a vestigial p², absent in the other, and the dorsal outline of the nasals forms a slight angle at the proximal third, instead of being evenly convex. The audital bullæ are also much less inflated. This discovery of the skull of the type specimen of *Felis braccata* renders it possible to assign with certainty the type locality of the species, on the basis of the collector's original field label.

Lynchailurus pajeros proves to be a wide-ranging, plastic group. While the color pattern and the general external and cranial characters remain almost unchanged through a geographic range of 34° of latitude (from about 18° to 52° S.) in the pampas country, and extends in the eastern Andean region to the equator, the color tones and texture of the pelage greatly vary locally, and the size of the animal decreases from south northward, as shown by the measurements of skulls given below. In the extreme south the color markings are indistinct except on the cheeks, limbs, throat and ventral surface, and the general tone is pale and the pelage long and coarse. In the middle districts (typical *pajeros* of Buenos Ayres), the general tone is more fulvous, the markings on the sides of the body more distinct, and elsewhere edged or suffused with fulvous. In the extreme north (*thomasi*, Quito) the pelage is much softer and shorter and the body markings are more strongly defined and reddish.

MEASUREMENTS OF SKULLS OF SUBSPECIES OF *Lynchaillurus pajeros*

	TOTAL LENGTH	CONDYLO- BASAL LENGTH	BASAL LENGTH	ZYGOM- ATIC BREADTH	INTER- ORBITAL BREADTH	POSTORB. CONSTR.	BREADTH OF BRAIN- CASE	LENGTH OF P ⁴
<i>L. pajeros crucina</i> ¹	108.2	96.0	91.7	78.6	22.2	29.5	46.4	11.6
<i>L. pajeros pajeros</i> ²	102.0	.....	.....	74.0	.....	.....	.....	.....
<i>L. pajeros braccatus</i> ³	93.0	89.3	82.1	62.2	18.1	29.7	42.2	11.6
<i>L. pajeros garleppi</i> ⁴	.....	87.0	78.3	66.0	18.2	28.5	.....	12.0
<i>L. pajeros thomasi</i> ⁵	88.0	82.0	76.0	64.0	16.5	24.8	41.0	10.0

¹No. 10005, ♂ ad., Rio Gallegos, Patagonia, lat. 52° S.²Type, No. 354, ♂ ad., Chapada, Mato Grosso, Brasil.³Type, ♂, Lönnerberg, loc. cit., p. 8.⁴Philippi, Arch. Naturg., XXXIX, Bd. 1, 1873, p. 15. Exact locality not stated.⁵Type, measurements from Lönnerberg, Arch. Zool., VIII, No. 16, July 1913, p. 9.

(see Lönnerberg's plate, *loc. cit.*). In *L. p. braccatus*, from the Upper Paraguay River, the body is dark gray with a faint tone of buff, the markings on the sides of the body are moderately pronounced, the black markings without fulvous edging, the limbs and feet blackish instead of gray.

The forms of this group are little known, three of them (so far as published records go) only from their respective type specimens, and representatives of the two older known forms appear to be extremely rare in collections.

HERPAILURUS SEVERTZOW

Herpailurus SEVERTZOW, Rev. et Mag. de Zool., (2) X, pp. 385, 390, Sept. 1858. Type, by monotypy, *Felis yaguarondi*. Proposed for the Yaguaroundi and Eyra of Azara, color phases of the same species.

Herpailurus Pocock, Ann. Mag. Nat. Hist., (8) XX, 1917, pp. 346, 350. Part; only the *H. yaguarondi* group.

The genus *Herpailurus* originally included only the slender-bodied, long-tailed, unspotted weasel-cats of the *yaguarondi* group, further well characterized by distinctive and well-known cranial characters. To this group the name is here restricted.

The *yaguarondi* group appears to be still poorly represented in museums and at present is very imperfectly known as to the regional forms that compose it. It presents two color phases, a gray and a red, which occur throughout its range, these phases having up to the beginning of the present century been supposed to represent different species, but for the last decade or so have been considered by specialists of the group as dichromatic conditions of a single species. Of the twenty specimens available for examination in this connection, the greater part are hunter's pelts, without skulls or flesh measurements. There is apparently very little difference in the external appearance of specimens from southern Matto Grosso, Brazil, on the one hand, and from Sinaloa, Mexico, and Cameron County, Texas, on the other. Several specimens from intermediate points, as Merida, Venezuela, the upper Rio Cauca region of Colombia, and Chiriqui, Panama, are quite different from either, in both phases of coloration. As there is evident in the material at hand a considerable amount of individual variation in specimens of each color phase, it seems the better course not to increase the names already existing until more representative material from many localities has been brought together.

1. *Herpailurus yaguarondi cacomitli* (Berlandier)¹

Figures 5c, 8b, 11b, 13c

Felis cacomitli BERLANDIER, MSS., in Baird, Rep. U. S. and Mex. Bound. Surv., II, Mamm., 1859, p. 12. Matamoras, Tamaulipas, Mexico. MEARNs, Proc. U. S. Nat. Mus., XXIV, p. 207, Oct. 4, 1901. Dark phase.

Felis cacomitli ALLEN, Bull. Amer. Mus. Nat. Hist., XXII, p. 222, July 25, 1906. Escuinapa, Sinaloa, Mexico.

Felis eyra BAIRD, Mamm. N. Amer. 1857, p. 88, Pl. LXII (animal); Rep. U. S. and Mex. Bound. Surv., II, Mamm., 1859, p. 10, Pl. II (animal), Pl. XII, fig. 2 (skull). Matamoras, Tamaulipas, Mexico. Red phase.

Felis apache MEARNs, Proc. Biol. Soc. Washington, XIV, p. 150 (in text), Aug. 9, 1901. Matamoras, Tamaulipas, Mexico. Red phase. New name for *Felis eyra* Baird.

Felis yaguarondi tolteca THOMAS, Ann. Mag. Nat. Hist., (7) I, p. 41, Jan. 1898. Tatameles, Sinaloa, Mexico. Dark phase. To replace *F. cacomitli*, considered unavailable.

?*Felis fossata* MEARNs, Proc. Biol. Soc. Washington, XIV, p. 150, Aug. 9, 1901. Merida, Yucatan. Based on a skull, sex not known.

The first four names in the above citations (*cacomitli*, *eyra*, *apache*, *tolteca*) all doubtless refer to the same form, three of them relating to specimens from Matamoras, Mexico; the other (*tolteca*) was given to replace *cacomitli*, considered to be untenable. The last name, *fossata*, was based on a single skull from Merida, Yucatan, of which the sex was not known. The description affords no characters that are distinctive, but on geographical grounds a query has been prefixed to the citation.

The dozen or more skulls before me at this writing include three from the vicinity of Brownsville, three from Escuinapa, Sonora; the others are from various localities, including a very large skull from San José, Costa

¹As the availability of the name *Felis cacomitli* Berlandier was formerly questioned, I give here its original basis and history.

The name first appeared as "*Felis cacomitli* Berl. MSS." in the synonymy under the heading "*Felis yaguarundi* Deamarest" in Baird's Mamm. N. Amer., 1858, p. 88. In the general text below Baird adds: "A skull (No. 1426) of this species, in the collection of Dr. Berlandiere, collected at Matamoras, with a full description of the animal by him, establishes a more northern distribution for this species than has hitherto been accorded."

Baird's report on the mammals of the Mexican Boundary, published a year later, contains (p. 12) the following, also under the heading *Felis yaguarundi*:

"The existence of this species on the Rio Grande, like the *F. eyra*, is established by a skull (1426) in the collection of Dr. Berlandiere, and a description in his MSS. as *Felis cacomitli*." The name was not adopted by Baird.

At the end of the account of *Felis yaguarundi*, on the next page (p. 13), the following is given in small type in marks of quotation:

"A kind of cat, or at least a digitigrade, common in Mexico before the conquest, but at present very rare.

"It is grey, but the hairs considered separately, are tinged with rufous and black; their extremities blackish.

"I have been assured that it is killed sometimes in the vicinity of Victoria, the capital of the State of Tamaulipas, and on the plateau of Mexico. On the borders of the Rio Bravo del Norte it is killed in the vicinity of Matamoras. I believe it is not found in Texas." (Berlandiere.)

Whatever may have been contained in Berlandier's "full description" mentioned by Baird, this is all that appears to have come down to us. Under present usage, however, the name *Felis cacomitli* is apparently available, having a tangible basis.

Rica. This skull is much larger than any of the others; it is also very old, and has a heavy lambdoid crest and a deep frontal sulcus. Whether these differences indicate a separable geographic form can be determined only by the examination of further material from the highlands of Costa Rica. The three specimens from Escuinapa vary in condylobasal length from 89.6 to 102 mm., and in zygomatic breadth from 58.5 to 77.4 mm., the extremes covering the range of a similar series from Brownsville, Texas. The same measurements in the Costa Rica specimen are 102 and 76.

2. *Herpailurus yaguarondi panamensis* (Allen)

Felis panamensis ALLEN, Bull. Amer. Mus. Nat. Hist., XX, p. 71, Feb. 20, 1904. Type locality, Boqueron, Chiriqui, Panama.

A very dark form known only from the type, a young adult female. Possibly the large skull from Costa Rica (collected near San José) is referable to this form.

Since describing this form, which I have still no doubt is entitled to recognition, two somewhat similar specimens (skins only) have been received from other and quite remote districts, which in their dark coloration strongly resemble the type of *panamensis*, especially characterized by a broad, black, median dorsal band extending to the tip of the tail, which latter is apically almost wholly black. In specimens from northern Mexico and Texas, and also from southern Matto Grosso, the dark dorsal band is either wholly absent or only incipiently developed. Specimens in the red phase from tropical regions, as Colombia and southern Bolivia, are far more intensely colored than are the specimens from either the northern or the southern border of the range of the group.

3. *Herpailurus yaguarondi melantho* (Thomas)

Felis yaguarondi melantho THOMAS, Ann. Mag. Nat. Hist., (8) XIII, 1914, p. 350. Pozuzo, Peru. Altitude 800 m.

Distinguished by large size, as indicated by an adult male and female on which the species is based. Condylobasal length of the two skulls: ♂ 111 mm., ♀ 101; zygomatic breadth, 75, 68. The same measurements of a large skull from San José, Costa Rica (referred to above), are 102 and 76.

In this connection Thomas makes the following interesting comment on the constituents of the *yaguarondi* group: "The different forms of the *yaguarondi* seem to be distinguishable by little but size, as their color varies exceedingly, specimens from the same locality, unquestionably

conspecific, often differing widely in their tone of grey, blackish, or rufous. The variation in the development of the protocone of the carnassial is also very striking, and it is well shown in the two specimens of the present form [*Felis jaguarondi melantho*], the male having it reduced (as is common in *jaguarondis*) and the female having quite a large one.

"The largest *jaguarondi* is this one from the Peruvian Andes, the central one from Venezuela to Argentina is intermediate in size, while the Guianian and Eastern Brazilian form, for which the name of *unicolor* is available, is the smallest of all."

4. *Herpailurus jaguarondi unicolor* (Traill)

Felis unicolor TRAILL, Mem. Wernerian Soc., III, 1819, p. 170, Pl. x (animal). "Demerary, Guyana."

[*Felis jaguarondi*] *unicolor* THOMAS, Ann. Mag. Nat. Hist., (8) XIII, 1914, p. 350 (in text).

This, according to Thomas (*loc. cit.*), is the smallest member of the group; he signalizes its range as the Guianas and eastern Brazil.

5. *Herpailurus jaguarondi jaguarondi* (Lacépède)

L'yagouaroundi, AZARA, Essais sur l'Hist. nat. Quad. du Paraguay, I, 1801, pp. 171-176, and Voy. dans l'Amér. Mérid., 1880, Atlas, Pl. x (animal).

Felis jaguarondi LACÉPÈDE, in Azara's Voy. dans l'Amér. Mérid., 1908, Pl. x (animal) = *L'Yagouroundi* of Azara. No technical name is applied to the *Yaguarondi* in the chapter on mammals in Volume I of the Voyage.

Felis jaguarondi G. CUVIER, Ann. du Mus. d'Hist. nat., XIV, 1809, p. 158 = *Felis jaguarondi* Lacépède.

Felis jaguarondi DESMAREST, Nouv. Dict. d'Hist. nat., VI, 1916, p. 113; Mammalogie, I, 1820, p. 250, No. 361 = *Felis jaguarondi* Lacépède.

L'Eyra AZARA, Essais sur l'Hist. nat. Quad. du Paraguay, I, 1801, pp. 177-178.

[*Felis*] *eyra* G. FISCHER, Zoognosia, III, 1814, p. 228 = *L'Eyra* of Azara.

Felis eira DESMAREST, Nouv. Dict. d'Hist. nat., VI, 1816, p. 114 = *L'Eyra* of Azara.

Felis eyra F. CUVIER, Dict. des Sci. nat., VIII, 1817, p. 250 = *L'Eyra* of Azara.

Felis L [eo] griseus Oken, Lehrb. Naturg., Theil 3, Zool., Abth. 2, 1816, p. 1070 = *L'Yaguarondi* of Azara.

Felis darwini MARTIN, Proc. Zool. Soc. London, 1837 (Oct. 3, 1837), pp. 3-4. Buenos Ayres. Gray phase. Skin (without skull?) of an immature specimen.

Paraguay, Argentina, and southern Brazil. "Paraguay to Argentina" (Thomas, *loc. cit.*, 1914).

The name *Felis jaguarondi* has usually been credited to Desmarest (1816 or 1820), and the name *Felis jaguarondi* to G. Fischer (1814). The figure of Azara's *yagouaroundi*, in the atlas to his 'Voyage dans l'Amerique meridionale' (Plate x), published in 1808, bears the legend:

"Le Yagouarondi D'Az. *Felis yaguarondi* Lacép." G. Cuvier, one year later (1809, *loc. cit.*), used the form *Felis jaguarondi*, crediting the name to Lacépède, and citing plate x of the collection of plates to Azara's 'Voyage' and "Le jaguarondi du Paraguay" "que M. d'Azzara nous a fait connoître le premier."

The name *Felis eyra*, also usually attributed to Desmarest, was given by G. Fischer (Zoognosia, III, p. 228) to Azara's Eyra, which he called *Felis eyra*, but he did not name Azara's Yagouarondi, which he merely mentioned under his *Felis catus* (p. 228) as a little known species. His citation is: "3. *Yaugouroundi*, AZARA, Paraguaia, I, 171." There is thus no basis for the "*Felis jaguarundi* Fischer, Zoogn., 1814, p. 228." so often met with as a citation.

LIST OF ILLUSTRATIONS

Skulls

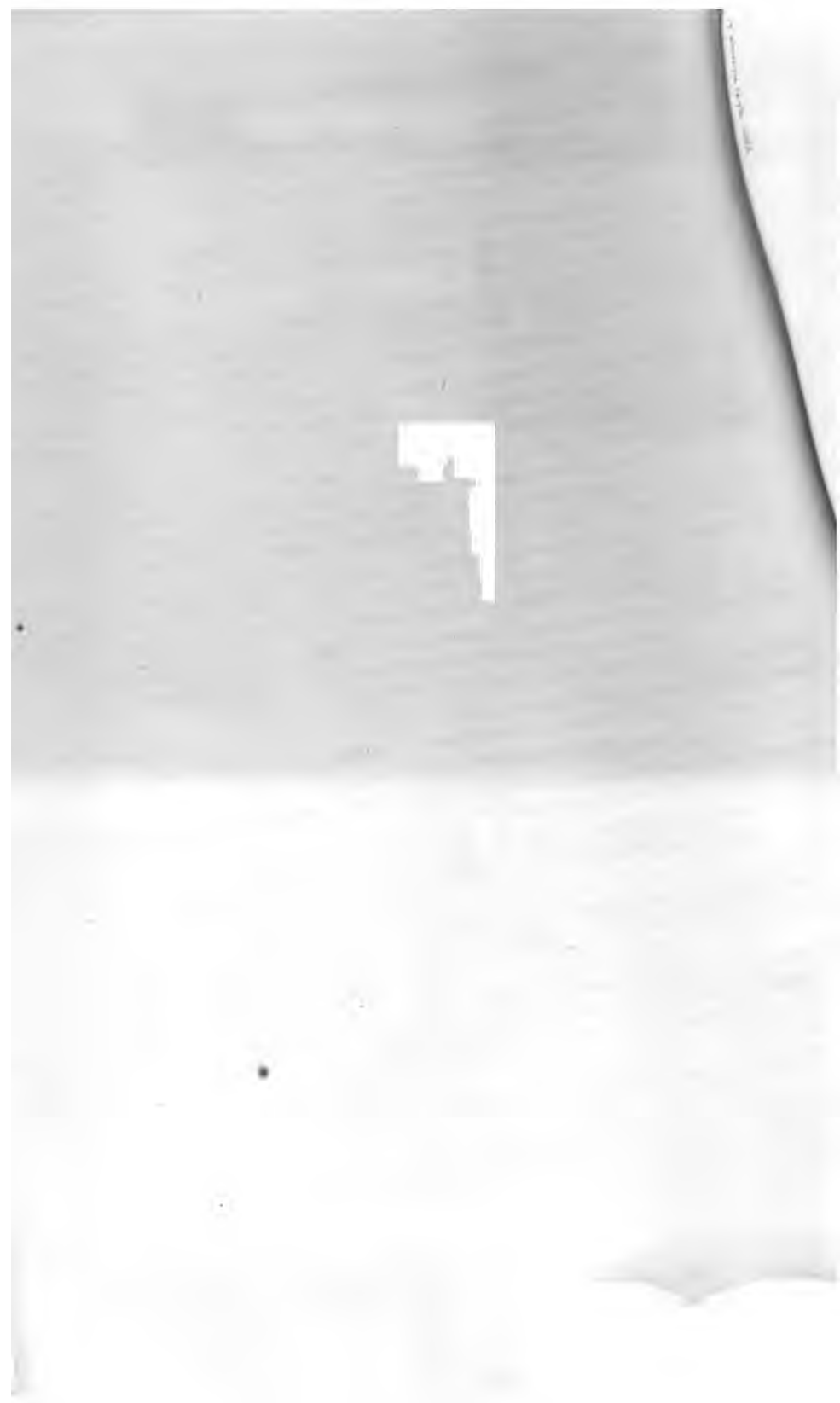
- Fig. 1. *Leopardus pardalis mearnsi* (Allen). No. 33189, ♂, Matagalpa, Nicaragua. Lateral view of skull. $\frac{1}{2}$.
- Fig. 2. *Leopardus pardalis mearnsi* (Allen). Dorsal view. $\frac{1}{2}$. Same skull as Fig. 1.
- Fig. 3. *Leopardus pardalis mearnsi* (Allen). Ventral view. $\frac{1}{2}$. Same skull as Figs. 1 and 2.
- Fig. 4a. *Margay tigrina wiedii* (Schinz). No. 352, ♂?, Chapada, Matto Grosso, Brazil. Lateral view. $\frac{1}{2}$.
- 4b. *Oncilla pardinoides emerita* (Thomas). No. 34349, ♂, Merida, Venezuela. Lateral view. $\frac{1}{2}$.
- 4c. *Noctifelis guigna* (Molina). No. 33283, ♂, Marquehue, Temuco, Chile. Lateral view. $\frac{1}{2}$.
- Fig. 5a. *Oncifelis geoffroyi* (D'Orbigny and Gervais). No. 16696, ♂, Cañada las Vacas, Patagonia (S. lat. 51°). Lateral view. $\frac{1}{2}$.
- 5b. *Oncifelis salinarum* (Thomas). No. 39010, ♂, Pulque, Sucre, Bolivia (alt. 9400 feet). Lateral view. $\frac{1}{2}$.
- 5c. *Herpailurus yaguarondi cacomilli* (Berlandier). No. 24853, ♂, Escuinapa, Sinaloa, Mexico. Lateral view. $\frac{1}{2}$.
- Fig. 6a. *Margay tigrina wiedii* (Schinz). Ventral view. $\frac{1}{2}$. Same skull as Figs. 4a, 9a, 12b.
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- Fig. 8a. *Oncifelis salinarum* (Thomas). Ventral view. $\frac{1}{2}$. Same skull as Figs. 5b, 11a, 13b.
- 8b. *Herpailurus yaguarondi cacomilli* (Berlandier). Ventral view. $\frac{1}{2}$. Same skull as Figs. 5c, 11c, 13c.
- Fig. 9a. *Margay tigrina wiedii* (Schinz). Dorsal view. $\frac{1}{2}$. Same skull as Figs. 4a, 6a, 12b.
- 9b. *Oncilla pardinoides emerita* (Thomas). Dorsal view. $\frac{1}{2}$. Same skull as Figs. 4b, 6a, 12c.
- Fig. 10a. *Noctifelis guigna* (Molina). Dorsal view. $\frac{1}{2}$. Same skull as Figs. 4c, 7a, 12a.
- 10b. *Oncifelis geoffroyi* (D'Orbigny and Gervais). Dorsal view. $\frac{1}{2}$. Same skull as Figs. 5a, 7b, 13a.
- Fig. 11a. *Oncifelis salinarum* (Thomas). Dorsal view. $\frac{1}{2}$. Same skull as Figs. 5b, 8a, 13b.
- 11b. *Herpailurus yaguarondi cacomilli* (Berlandier). Dorsal view. $\frac{1}{2}$. Same skull as Figs. 5c, 8b, 13c.

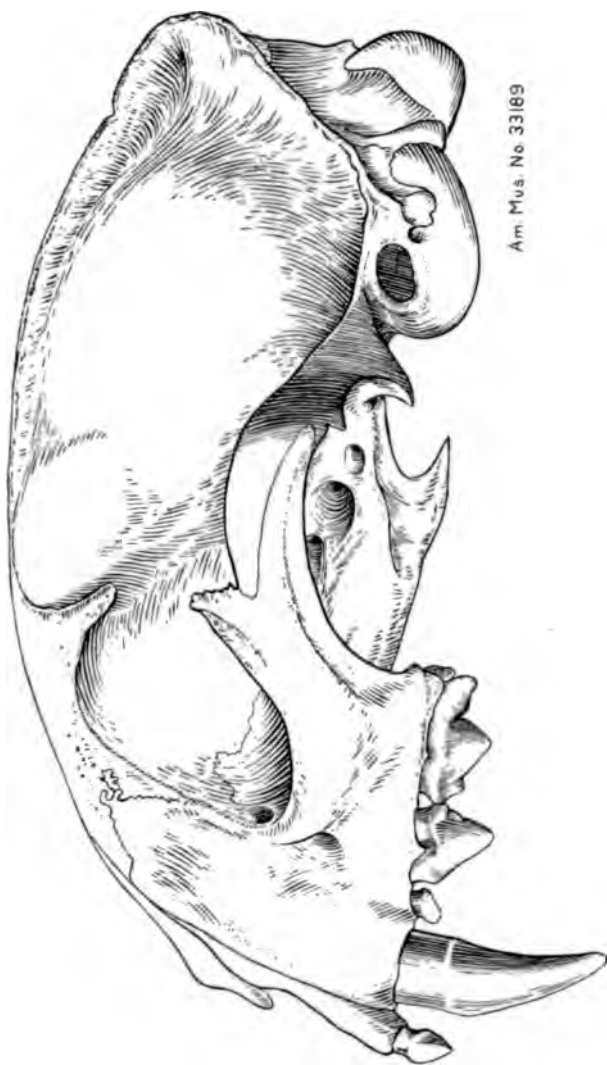
- Fig. 12a. *Leopardus pardalis mearnsi* (Allen). $\frac{1}{2}$. Same skull as Figs. 1-3.
 12b. *Margay tigrina wiedii* (Schinz). $\frac{1}{2}$. Same skull as Figs. 4a, 6a, 9a.
 12c. *Oncilla pardinoides emerila* (Thomas). $\frac{1}{2}$. Same skull as Figs. 4b, 6b, 9b.
 12d. *Noctifelis guigna* (Molina). $\frac{1}{2}$. Same skull as Figs. 4c, 7a, 10a.
 Fig. 13a. *Oncifelis geoffroyi* (Gervais and D'Orbigny). $\frac{1}{2}$. Same skull as Figs. 5a, 7b, 10b.
 13b. *Oncifelis salinarum* (Thomas). $\frac{1}{2}$. Same skull as Figs. 5b, 8a, 11a.
 13c. *Herpailurus yaguarondi cacomilli* (Berlandier). $\frac{1}{2}$. Same skull as Figs. 5c, 8b, 11b.

Skins

- Fig. 14. *Leopardus pardalis chibigouazou* (Griffith). No. 41303, Descalvados, Matto Grosso, Brazil. George K. Cherrie, Roosevelt South American Expedition. Ground color of upperparts ochraceous buff. $\frac{1}{2}$.
 Fig. 15. *Leopardus pardalis chibigouazou* (Griffith). No. 41309, Descalvados, Matto Grosso, Brazil. George K. Cherrie, Roosevelt South American Expedition. Ground color of upperparts ochraceous buff, a little paler than in No. 41303. $\frac{1}{2}$.
 Fig. 16. *Leopardus pardalis chibigouazou* (Griffith). No. 41308, Descalvados, Matto Grosso, Brazil. George K. Cherrie, Roosevelt South American Expedition. Ground color of upperparts light ochraceous buff. $\frac{1}{2}$.
 Fig. 17. *Leopardus pardalis chibigouazou* (Griffith). No. 41307, Descalvados, Matto Grosso, Brazil. George K. Cherrie, Roosevelt South American Expedition. Ground color of upperparts light ochraceous buff. $\frac{1}{2}$.
 Fig. 18. *Leopardus pardalis chibigouazou* (Griffith). No. 41306, Descalvados, Matto Grosso, Brazil. George K. Cherrie, Roosevelt South American Expedition. Ground color of upperparts light buff. $\frac{1}{2}$.
 Fig. 19. *Leopardus pardalis tumatumari* (Allen). No. 40837, near Santarem, Brazil. George K. Cherrie, Collins-Day South American Expedition. Ground color tawny and white. $\frac{1}{2}$.
 Fig. 20a. *Noctifelis guigna* (Molina). No. 33287, ♀, Marquehue, Temuco, Cautin, Chili, July 19, 1910. D. S. Bullock. Dorsal view. Ground color ochraceous buff, markings deep black. $\frac{1}{2}$.
 20b. *Noctifelis guigna* (Molina). No. 33283, ♂, Marquehue, Temuco, Cautin, Chili, June 8, 1911. D. S. Bullock. Dorsal view. Ground color slightly lighter than in No. 33287 and black markings coarser, giving a much darker general effect. $\frac{1}{2}$.
 Fig. 21. *Noctifelis guigna* (Molina). Same specimens as Figs. 20a and 20b. Side view.
 Fig. 22. *Noctifelis guigna* (Molina). Same specimens as Figs. 20a, 20b. Ventral view. Ground color of foreneck and underside of tail light buff, rest of underparts clear white.

23. *Oncifelis geoffroyi* (D'Orbigny and Gervais). No. 16696, ♂, Cañada las Vacas, Patagonia (S. lat. 51°), July 26, 1899. Barnum Brown. The markings are black, the ground color light gray faintly toned with pale buff. For comparison with *O. salinarum*. $\frac{1}{4}$.
24. *Oncifelis salinarum* (Thomas). No. 39010, ♂, Pulque, Sucre, Bolivia, alt. 9400 feet, Nov. 25, 1915. Leo E. Miller and H. S. Boyle. Markings black, ground color buff. $\frac{1}{4}$.
25. *Oncifelis salinarum* (Thomas). No. 39004, ♂, Rio Cachimayo, Sucre, Bolivia, alt. 8700 feet, Dec. 9, 1915. Miller and Boyle. Markings black, ground color deep buff, a little deeper than in No. 39010. $\frac{1}{4}$.
26. *Oncifelis salinarum* (Thomas). No. 41550, ♂?, Lavallo, Santiago del Estero, alt. 1800 feet, July 8, 1916, Miller and Boyle. Ground color buff, indistinguishable in tone from that of No. 39010. $\frac{1}{4}$.
27. *Oncifelis salinarum* (Thomas). No. 41553, ♀, Lavallo, Santiago del Estero, Argentina, alt. 1800 feet, June 30, 1916. Miller and Boyle. Ground color pale buff. The white patch on the neck is due to bare skin, the hair having been lost through imperfect preservation. $\frac{1}{4}$.
28. *Oncifelis salinarum* (Thomas). No. 41554, ♂?, Lavallo, Santiago del Estero, Argentina, alt. 1800 feet, July 8, 1916. Miller and Boyle. Ground color pale buff, indistinguishable from that of No. 39010. $\frac{2}{11}$.
29. *Oncifelis salinarum* (Thomas). No. 41555, ♂?, Lavallo, Santiago del Estero, Argentina, alt. 1800 feet, July 8, 1916. Miller and Boyle. Ground color gray with a faint buffy tone. $\frac{1}{4}$.
0. *Lynchailurus pajeros braccata* (Cope). Type, Museum of Philadelphia Academy of Natural Sciences. Chapada, Matto Grosso, Brazil. Side view of mounted specimen. $\frac{1}{4}$.
1. *Lynchailurus pajeros braccata* (Cope). Same specimen as Fig. 30. Dorsal and ventral views. $\frac{1}{4}$.





Am Mus. No. 33189

Fig. 1. *Leopardus pardalis mearnsi* (Allen). No. 33189, ♂, Matagalpa, Nicaragua. Lateral view of skull. $\times 1$.

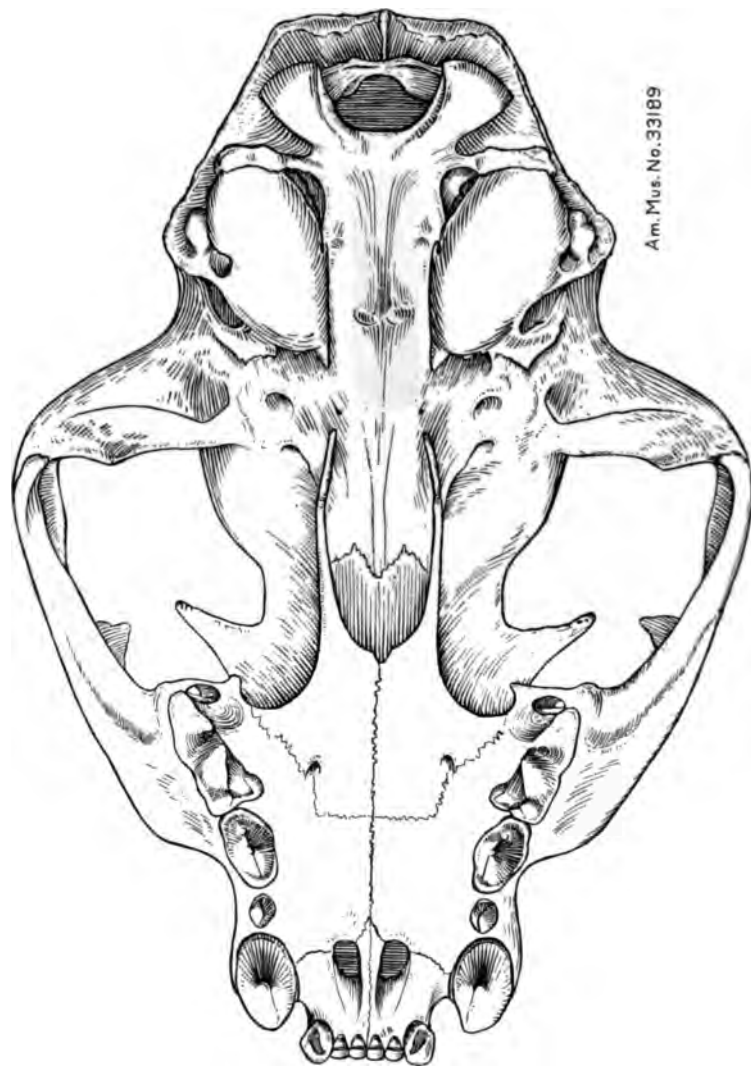


Fig. 2. *Leopardus pardalis mearnsi* (Allen). Dorsal view. $\frac{1}{4}$. Same skull as Fig. 1.

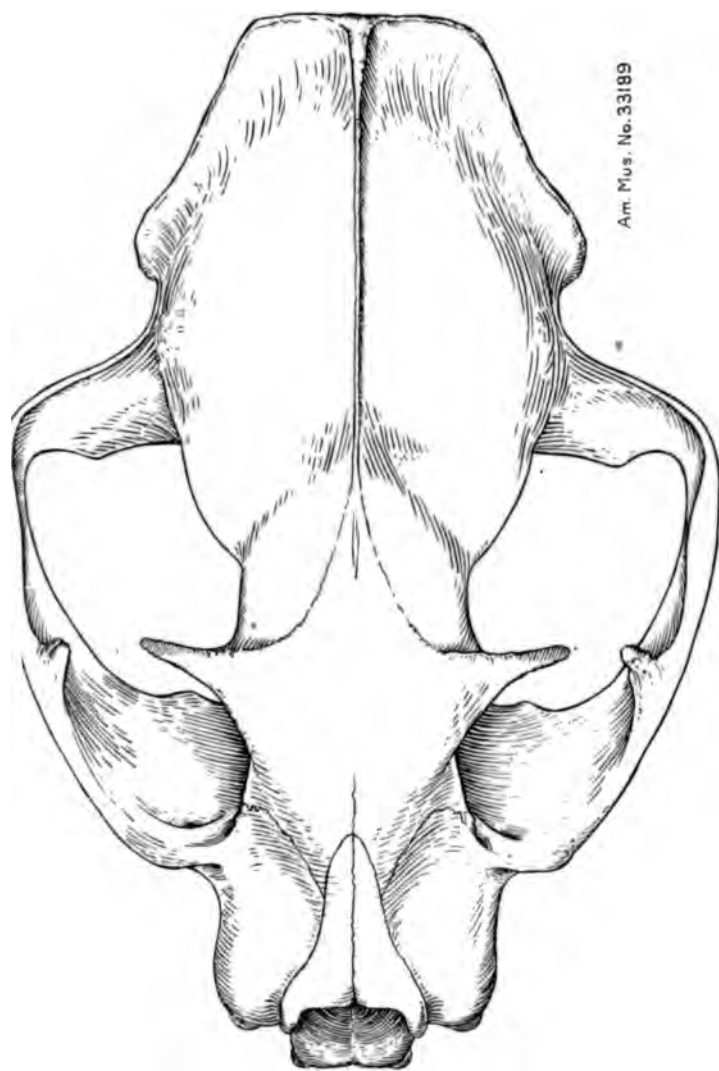


Fig. 3. *Leopardus pardalis mearnsi* (Allen). Ventral view. $\frac{1}{4}$. Same skull as Figs. 1 and 2.

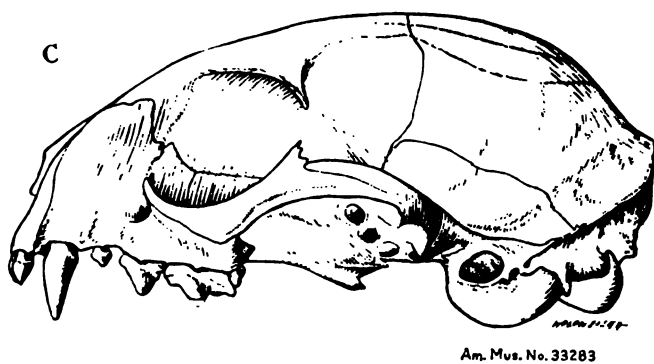
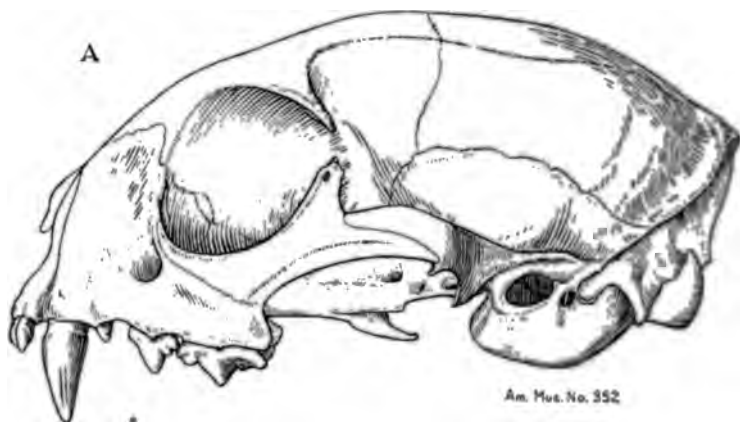


Fig. 4a. *Margay tigrina wiedii* (Schins). No. 352, ♂, Unapada, Matto Grosso.
 Fig. 4b. *Oncilla pardinoides emerita* (Thomas). No. 34349, ♂, Merida, Venezuela. L.
 Fig. 4c. *Noctifelis guigna* (Molina). No. 33283, ♂, Marqueshue, Temuco, Chile. L.

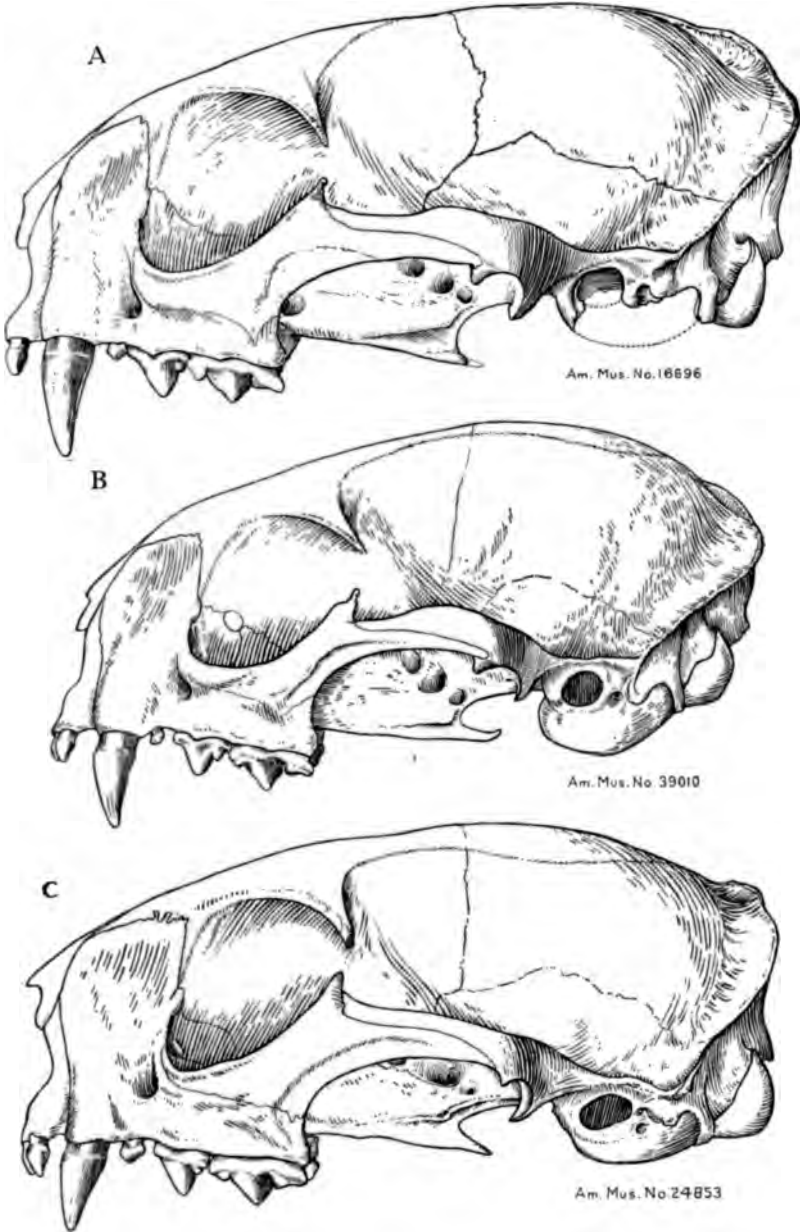


Fig. 5a. *Oncifelis geoffroyi* (D'Orbigny and Gervais). No. 16696, ♂, Cañada las Vacas Patagonia (S. lat. 51°). Lateral view. $\frac{1}{4}$.
 Fig. 5b. *Oncifelis salinarum* (Thomas). No. 39010, ♂, Pulque, Sucre, Bolivia (alt. 9400 feet). Lateral view. $\frac{1}{4}$.
 Fig. 5c. *Herpailurus yaguarondi cacomilli* (Berlandier). No. 24853, ♂, Escuinapa, Sinaloa, Mexico. Lateral view. $\frac{1}{4}$.

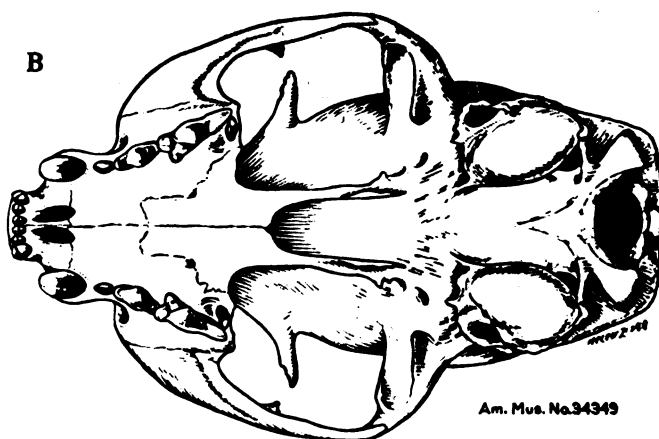
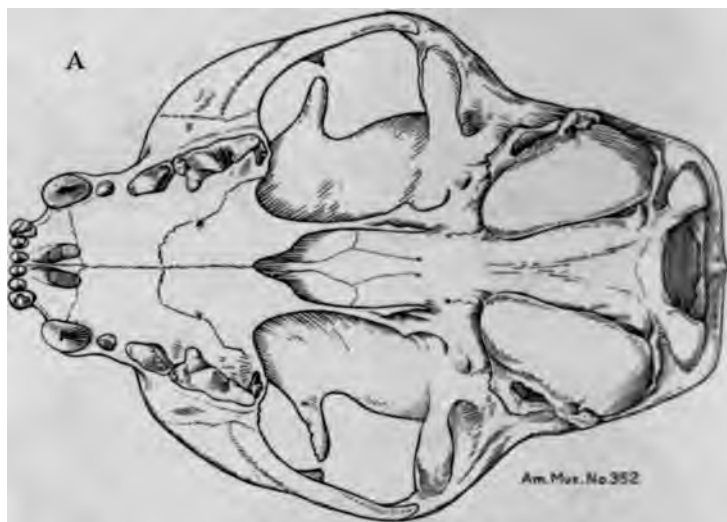


Fig. 6a. *Margay tigrina wiedii* (Schins). Ventral view. $\frac{1}{4}$. Same skull as Figs. 4a, 9a, 12a.
 Fig. 6b. *Oncilla pardinoides emerita* (Thomas). Ventral view. $\frac{1}{4}$. Same skull as Figs. 4b, 9b, 12b.

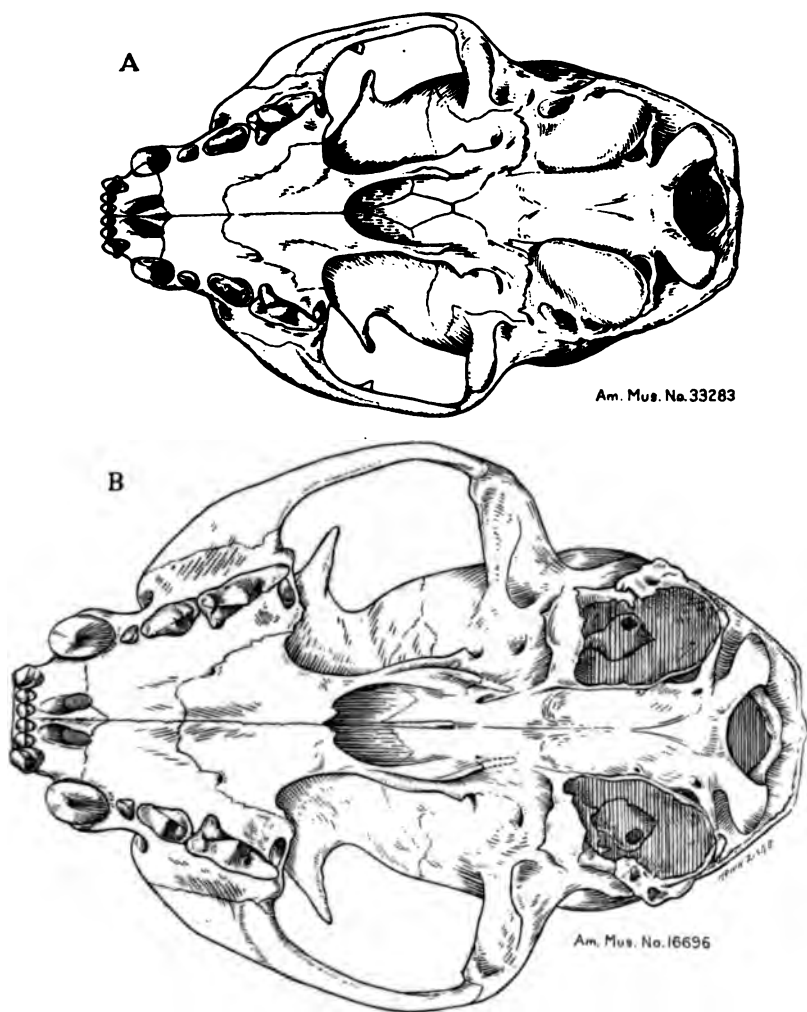


Fig. 7a. *Noctifelis guigna* (Molina). Ventral view. ♂. Same skull as Figs. 4c, 10a, 12d.
 Fig. 7b. *Oncifelis geoffroyi* (D'Orbigny and Gervais). Ventral view. ♂. Same skull as Figs. 5a, 10b, 13a.

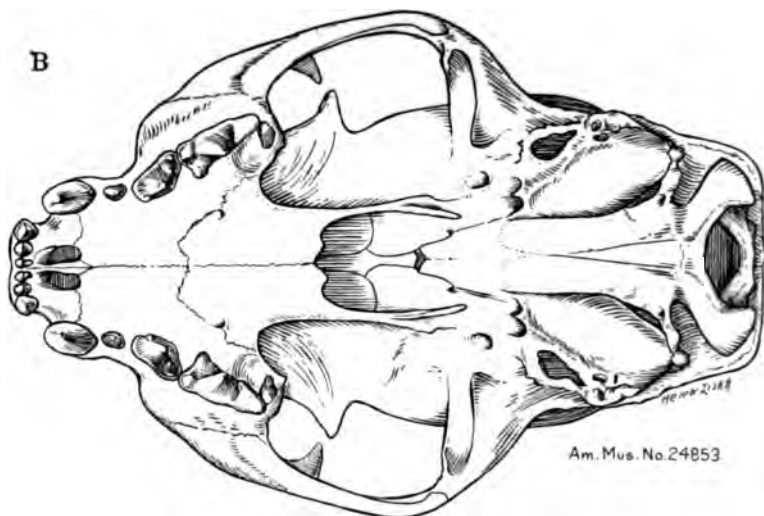
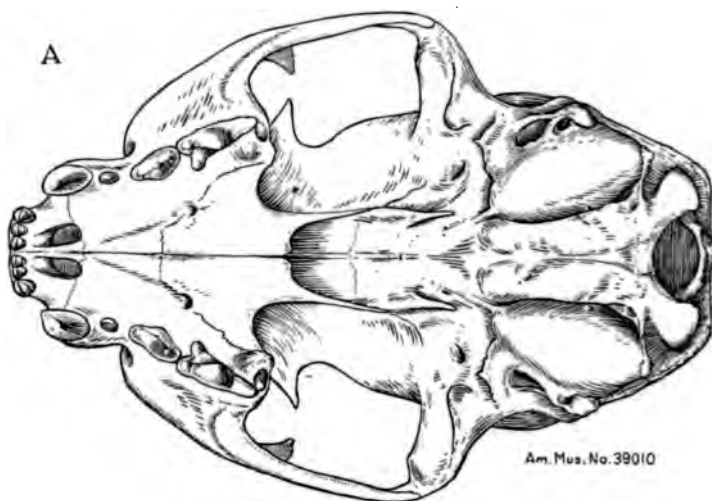


Fig. 8a. *Oncifelis salinarum* (Thomas). Ventral view. $\frac{1}{2}$. Same skull as Figs. 5b, 11a, 13b.
 Fig. 8b. *Herpailurus yagouaroundi cacomilli* (Berlandier). Ventral view. $\frac{1}{2}$. Same skull as Figs. 5c, 11c, 13c.

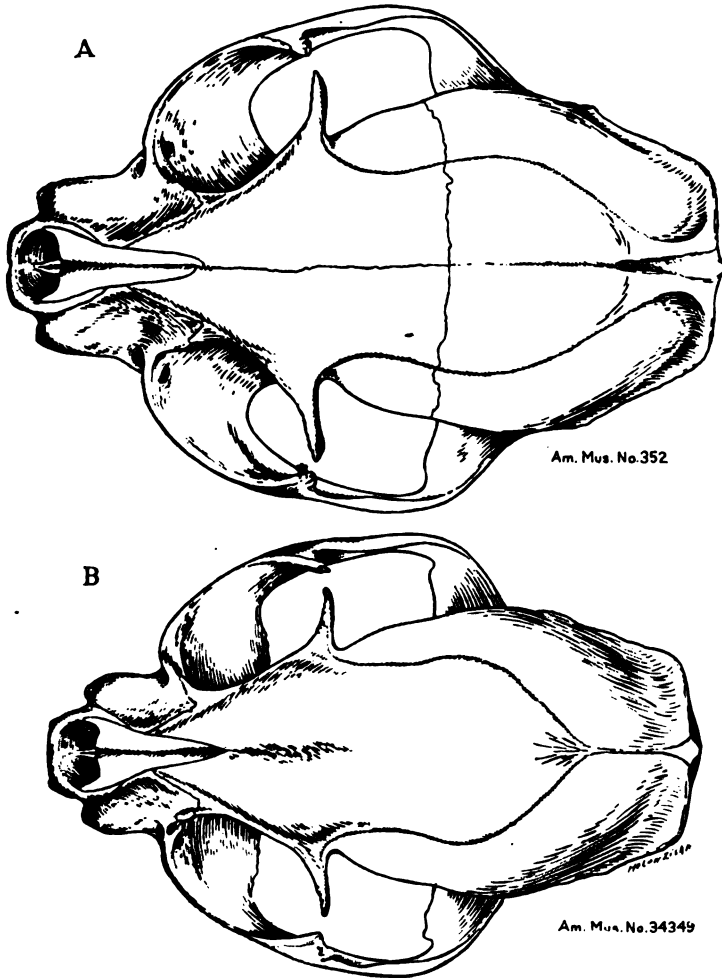


Fig. 9a. *Margay tigrina wiedii* (Schins). Dorsal view. $\frac{1}{4}$. Same skull as Figs. 4a, 6a, 12b.
 Fig. 9b. *Oncilla pardinaoides emerita* (Thomas). Dorsal view. $\frac{1}{4}$. Same skull as Figs. 4b, 6a, 12c.

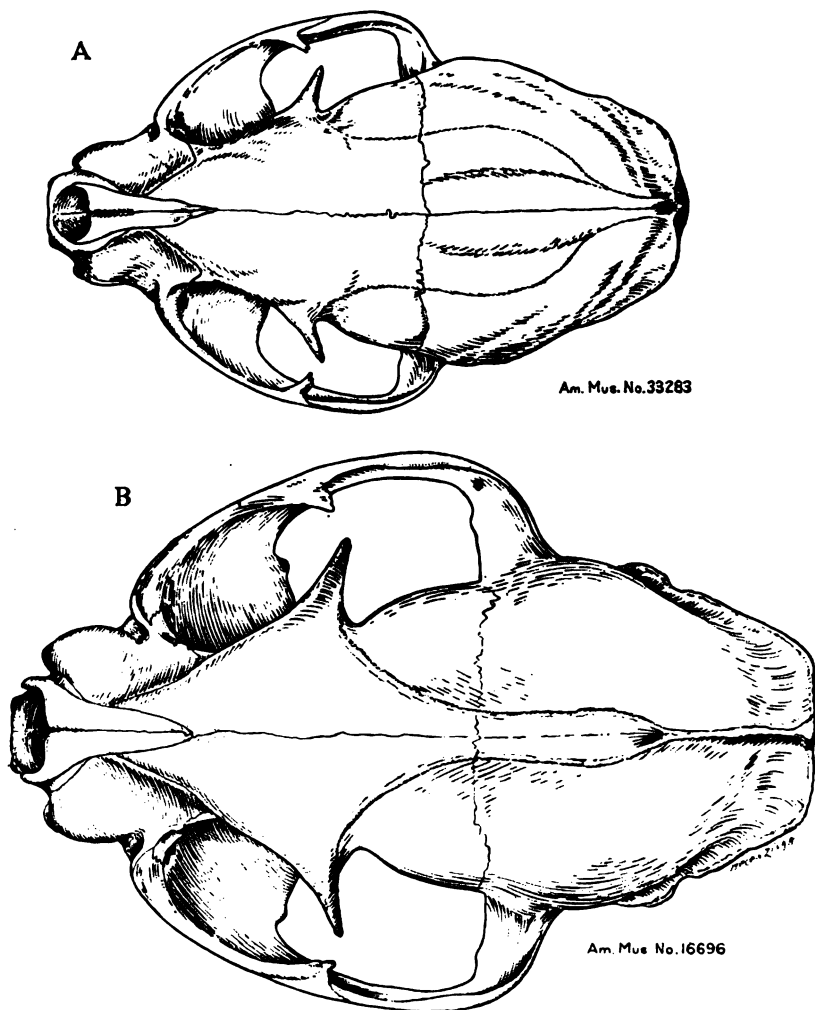


Fig. 10a. *Noctifelis guigna* (Molina). Dorsal view. $\frac{1}{2}$. Same skull as Figs. 4c, 7a, 12a.
 Fig. 10b. *Oncifelis geoffroyi* (D'Orbigny and Gervais). Dorsal view. $\frac{1}{2}$. Same skull as Fig. 5a, 7b, 13a.

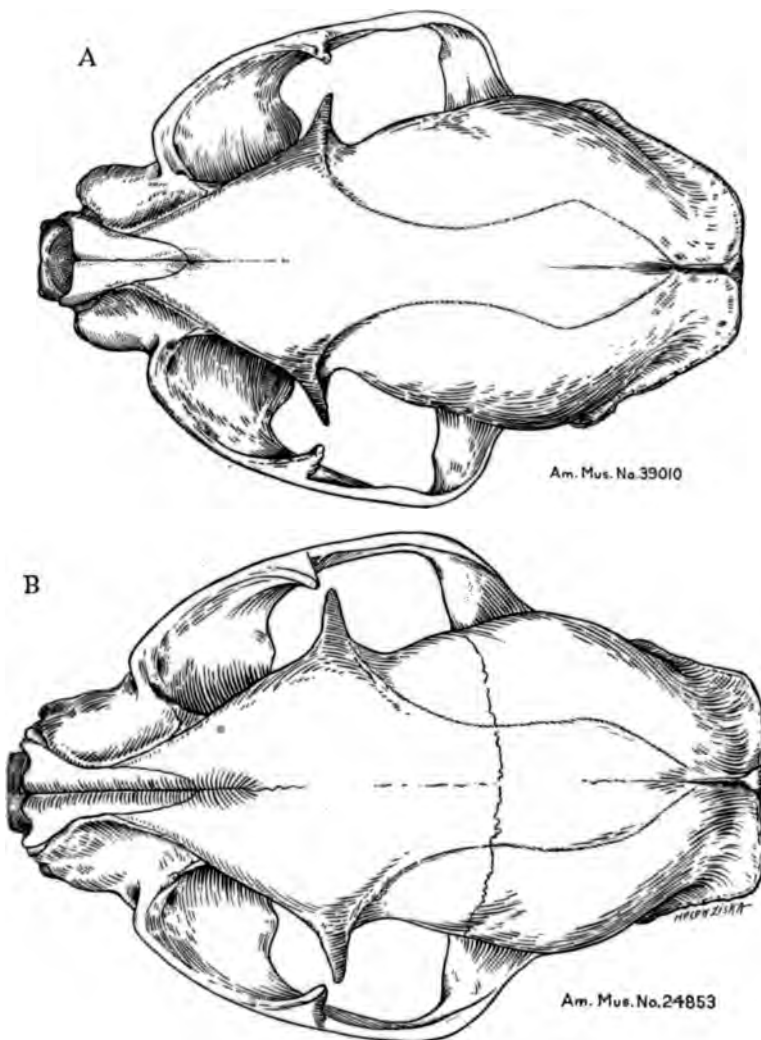


Fig. 11a. *Oncifelis salinarum* (Thomas). Dorsal view. $\frac{1}{2}$. Same skull as Figs. 5b, 8a, 13b.
 Fig. 11b. *Herpailurus yagouaroundi cacomilli* (Berlandier). Dorsal view. $\frac{1}{2}$. Same skull as
 Figs. 5c, 8b, 13c.

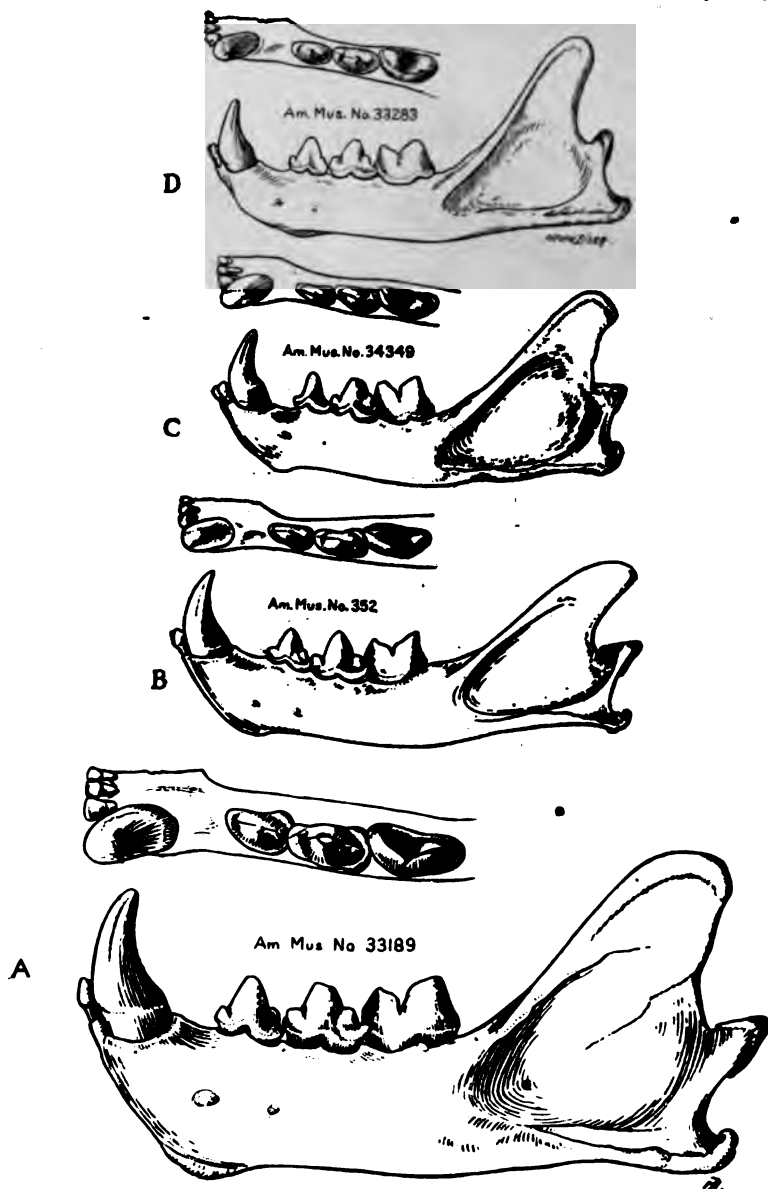


Fig. 12a. *Leopardus pardalis mearnsi* (Allen). $\frac{1}{2}$. Same skull as Figs. 1-3.
 Fig. 12b. *Marpay tigrina wiedii* (Schinz). $\frac{1}{2}$. Same skull as Figs. 4a, 6a, 9a.
 Fig. 12c. *Oncilla pardinoidea emerita* (Thomas). $\frac{1}{2}$. Same skull as Figs. 4b, 6b, 9b.
 Fig. 12d. *Noctifelis guigna* (Molina). $\frac{1}{2}$. Same skull as Figs. 4c, 7a, 10a.

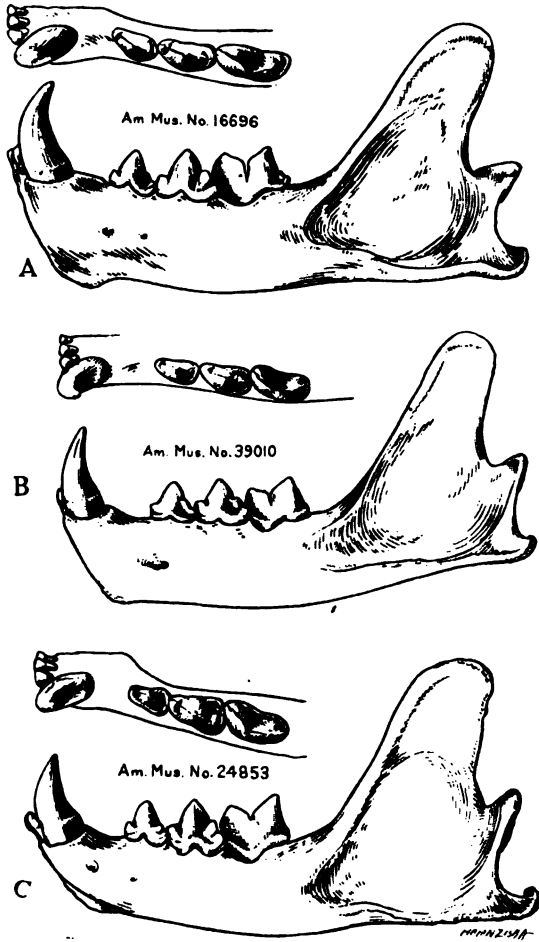


Fig. 13a. *Oncifelis geoffroyi* (Gervais and D'Orbigny). $\frac{1}{4}$. Same skull as Figs. 5a, 7b, 10b
 Fig. 13b. *Oncifelis salinarum* (Thomas). $\frac{1}{4}$. Same skull as Figs. 5b, 8a, 11a.
 Fig. 13c. *Herpailurus yaguarondi cacomilli* (Berlandier). $\frac{1}{4}$. Same skull as Figs. 5c, 8b, 11b.



Fig. 14. *Leopardus pardalis chibigouazou* (Griffith). No. 41303, Descalvados, Matto Grosso, Brazil. George K. Cherrie, Roosevelt South American Expedition. Ground color of upperparts ochraceous buff. ♀.



Fig. 15. *Leopardus pardalis chibiquazou* (Griffith). No. 41309, Descalvados, Matto Grosso, Brazil. George K. Cherrie, Roosevelt South American Expedition. Ground color of upperparts brassy buff, a little paler than in No. 41303. 1/2 in.



Fig. 16. *Leopardus pardalis chibigouazou* (Griffith). No. 41308, Descalvados, Matto Grosso, Brazil. George K. Cherrie, Roosevelt South American Expedition. Ground color of upperparts light ochraceous buff. $\frac{3}{8}$.

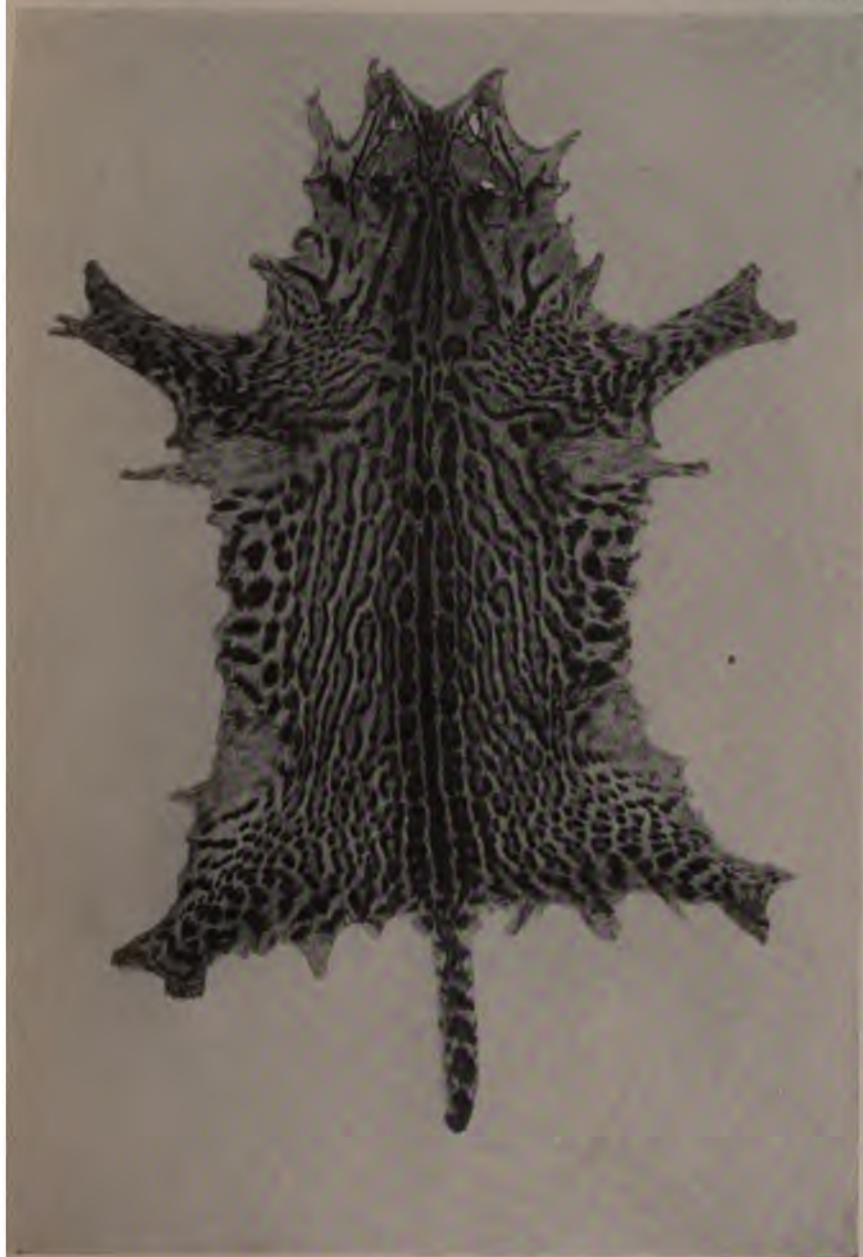


Fig. 17. *Leopardus pardalis chibiquazou* (Griffith). No. 41307. Descalvados, Matto Grosso, Brazil. George K. Cherrie, Roosevelt South American Expedition. Ground color of upperparts light ochraceous buff. $\frac{1}{2}$.



Fig. 18. *Leopardus pardalis chibigouazou* (Griffith). No. 41306, Descalvados, Mato Grosso, Brazil. George K. Cherrie, Roosevelt South American Expedition. Ground color of upperparts light buff. 3s.



Fig. 19. *Leopardus pardalis tumatumari* (Allen). No. 40837, near Santarem, Brazil. George K. Cherrie, Day South American Expedition. Ground color tawny and white. $\frac{1}{2}$



Fig. 20a. *Noctifelis guigna* (Molina). No. 33287, ♀, Marquhue, Temuco, Cautin, Chile, July 19, 1910. D. S. Bullock. Dorsal view. Ground color ochraceous buff, markings deep black. $\frac{1}{2}$.
 Fig. 20b. *Noctifelis guigna* (Molina). No. 33283, ♂, Marquhue, Temuco, Cautin, Chile, June 8, 1911. D. S. Bullock. Dorsal view. Ground color slightly lighter than in No. 33287 and black markings coarser, giving a much darker general effect. $\frac{1}{2}$.



21a and b. *Noctifelis guigna* (Molina). Same specimens as Figs. 20a and 20b. Side view.



* Figs. 22a and b. *Noctifelis guigna* (Molina). Same specimens as Figs. 20a and 20b. Ventral view. Ground color of foreneck and underside of tail light buff, rest of underparts clear white.



Fig. 23. *Oncifelis geoffroyi* (D'Orbigny and Gervais). No. 16696, ♂, Cañada las Vacas, Patagonia (S. lat. 51°), July 26, 1899. Barnum Brown. The markings are black, the ground color light gray faintly toned with pale buff. $\frac{1}{2}$.



Fig. 24. *Oncifelis salinarum* (Thomas). No. 39010 ♂, Pulque, Sucre, Bolivia, shot, Nov. 25, 1915. Leo. E. Miller and H. S. Boyle. Markings black, ground color buff.



Fig. 25. *Oncifelis salinarum* (Thomas). No. 39004, ♂, Rio Cachimayo, Sucre, Bolivia, alt. 8700 feet, Dec. 9 1915. Miller and Boyle. Markings black, ground color deep buff, a little deeper than in No. 39010. '4



Fig. 26. *Oncifelis solinarum* (Thomas). No. 41550, ♂, Lavalle, Santiago del Estero, Argentina, alt. 1800 feet, July 8, 1916. Miller and Royle. Ground color buff, indistinguishable in tone from that of No. 39010. ³⁴



Fig. 27. *Oncifelis salinarum* (Thomas). No. 41553, ♀, Lavalle, Santiago del Estero, Argentina, alt. 1800 feet, June 30, 1916. Miller and Boyle. Ground color pale buff. The white patch on the neck is due to bare skin, the hair having been lost through imperfect preservation. $\frac{1}{8}$



Fig. 28. *Oncifelis valinorum* (Thomas). No. 41554, ♂?, Laval, Santiago del Estro, Argentina, alt. 1800 feet, July 8, 1916. Miller and Boyle. Ground color pale buff, indistinguishable from that of No. 39010. Pl.



Fig. 29. *Oncifelis salinarum* (Thomas). No. 41555, ♂?, Lavalle, Santiago del Estro, Argentina, alt. 1800 feet, July 8, 1916. Miller and Boyle. Ground color with a faint gray buffy tone. 34.

BULLETIN A. M. N. H.



Academy of Natural Sciences. Chapada.
Museum of Natural History
Type specimen, Chapada.



Fig. 31. *Lynchaeturus pajeros braccata* Cope. Same specimen as Fig. 30. Dorsal and ventral views. 14.

VIII.—A REVISED LIST OF THE DIPTERA OF JAMAICA

BY CHARLES W. JOHNSON

PHORIDÆ BY CHARLES T. BRUES

In 1894 (Proc. Acad. Nat. Sci. Phila., pp. 271–281), the author published a list of the Diptera of Jamaica, based on a collection made by Wm. J. Fox and the writer at Kingston and Port Antonio in April and the early part of May 1891, together with those previously described from the Island. A supplement to this list was published by Prof. T. Cockerell in the same journal and volume, page 419. A number of altered descriptions have since appeared at various times, but the author's paper bearing directly on the dipteran fauna of the Island published by the Institute of Jamaica in 1905, *The Mosquitoes and other Diptera of Jamaica* by Fred. B. Theobald, with descriptions of some of the various stages by M. Graham. In the present list the Culicidæ have been rearranged and corrected according to the classification in the *Diptera* of North and Central America and the West Indies by W. H. Howard, Dyar, and Knab.

The writer has had the privilege of studying the collections made by Dr. John A. Grossbeck, Dr. Joseph A. Cushman, Dr. Charles W. Smith, Mrs. George L. Chaney, and Prof. Charles T. Brues. Prof. Brues has kindly contributed the part on the family Phoridae. The writer is indebted to Dr. A. L. Melander for assistance on the Empidæ and to Dr. A. H. Sturtevant on the Drosophilidæ. The list of 1894, which contained 115 species, has been corrected in the present list, which contains 322 species and varieties, 19 of which are new.

Our knowledge of the distribution of the tropical Diptera is still inadequate to form any definite conclusion. The following figures, however, will give an approximate idea of their general distribution. The number recorded from Jamaica exclusively includes only those whose distribution is determined specifically.

Recorded only from Jamaica 83
Recorded also from the following localities:

Cuba	70
Porto Rico	57
St. Vincent	37
United States	112
Mexico and Central America	74
South America	66

TIPULIDÆ

Geranomyia intermedia (Walker). "Jamaica," (Walker).

Rhipidia domestica Osten Sacken. Balaclava, (Cockerell),
U. S. Nat. Mus.

Limnobia sp. Balaclava, (Cockerell), U. S. Nat. Mus.

Gonomyia slossonæ Alexander, 1914, Proc. Acad. Nat. Sci.
Phila., XXVII, p. 588, Fig. 26. Kingston, April.

Gonomyia (Leiponeura) puer Alexander, 1913, Proc. U. S.
Nat. Mus., XLIV, p. 506, Pl. LXVI, fig. 14. Kingston, April.

Sacandaga parva Alexander, 1913, Proc. U. S. Nat. Mus., XLIV,
p. 508. Yallahs Valley, Blue Mts., Feb. 24, 1911, (Busck).

Limnophila nacrea Alexander, 1913, Proc. U. S. Nat. Mus.,
XLIV, p. 544. Cinchona, Feb. 24, 1911, (Grossbeck), Amer. Mus. Nat.
History.

PSYCHODIDÆ

Psychoda sp.? Jamaica, (Cockerell).

CHIRONOMIDÆ

Oecacta furens Poey. Jamaica, (Townsend).

CULICIDÆ

Wyeomyia mitchellii (Theobald). *Dendromyia mitchellii* Theobald, 1905, Mosquitoes of Jamaica, p. 37, Inst. Jamaica. Kingston, Jamaica, Feb. 11, (M. Grabham).

Wyeomyia grayii Theobald. Red Hills and Bath Botanic Garden, (M. Grabham).

Deinocerites cancer Theobald. Near Kingston, (M. Grabham). The larvæ live in "crab-holes."

Culex corniger Theobald. Kingston, (M. Grabham).

Culex annulipes (Theobald). *Melanoconium annulipes* Theobald, 1907, Mon. Culic., IV, p. 512. Red Hills, (M. Grabham).

Culex janitor Theobald. Kingston, in crab-holes along the sea-shore, (M. Grabham).

Culex secutor Theobald. Cinchona, 4900 ft.; Mavis Bank, 3500 ft.; Red Hills; Kingston; Newcastle, April 10, (M. Grabham). Abundant, especially after heavy autumnal rains.

Culex similis Theobald. Red Hills, Kingston, March, (M. Grabham).

Culex revocator Dyar and Knab. Hope Gardens and Newcastle, (M. Grabham).

Culex quinquefasciatus Say. *C. fatigans* Wiedemann. Theobald, 1905, Mosquitoes of Jamaica, p. 27. Jamaica, (Theobald).

Culex atratus Theobald. *Melanoconium atratus* Theobald, 1905, Mosquitoes of Jamaica, p. 28. In Jamaica it is found in abundance at the Ferry Swamp, (Theobald). Kingston, April, (M. Grabham).

Culex reductor Dyar and Knab. *Mochlostyrax jamaicensis* Grabham (not *Culex jamaicensis* Theobald), 1906, Can. Ent., XXXVIII, p. 318. Kingston, (M. Grabham).

Culex microsquamosus Grabham. In algæ-covered pools at the Rio Cobre, Canal Dam, near Spanish Town, Jan. 17, 1905, (M. Grabham).

Culex subfuscus Theobald. Monaque, Feb., (Lord Walsingham).

Masonia titillans (Walker). Kingston, Nov. 16, 1906, (M. Grabham).

Psorophora posticatus (Wiedemann). Kingston, (M. Grabham).

Psorophora johnstonii (Grabham). Red Hills, Molynes Road, Kingston, July 1905, (M. Grabham).

Psorophora jamaicensis (Theobald). Runaway Bay, (Lord Walsingham); Kingston, (Grabham).

Psorophora pygmæa (Theobald). *Grabhamia pygmæa* Theobald, 1905, Mosquitoes of Jamaica, p. 31. Kingston, Oct. 10, 1903, April 1906, (M. Grabham).

Psorophora haruspicus (Dyar and Knab). Port Antonio, bred from the larvæ in seaside pools, No. 15, 1906, (M. Grabham).

Aedes sollicitans (Walker). *Grabhamia sollicitans* (Walker) Theobald, 1905, Mosquitoes of Jamaica, p. 32. "Jamaica," (Theobald).

Aedes niger (Giles). *Culex tæniorhynchus* Theobald (in part) not Wiedeman. Jamaica, (M. Grabham).

Aedes scapularis (Rondani). *Culex confirmatus* Theobald, 1905, Mosquitoes of Jamaica, p. 25. Red Hills and Rockport near Kingston, (M. Grabham).

Aedes pertinax Grabham. Red Hills, Kingston, June-July, (M. Grabham).

Aedes tortilis (Theobald). *Culex tortilis* Theobald, 1905, Mosquitoes of Jamaica, p. 26. Kingston, July 10, 1906, (M. Grabham).

Aedes mediovittata (Coquillett). Waverly estate: Constant Spring and woods above Rockport, near Kingston, (M. Grabham). "Larvæ collected from hollow trees."

Aedes argenteus (Poiret). "Yellow fever Mosquito."
Culex argenteus Poiret, 1787, Journ. de Physique, XXX, p. 245.
Culex fasciatus Fabricius (*non* Müller), 1805, Syst. Antliat., p. 36.
Culex calopus Meigen, 1818, Syst. Besch., I, p. 3.
Stegomyia fasciata and *calopus* of authors. Kingston, July, (Cockerell). Hope Bay, May.

Aedes walkeri (Theobald). *Howardina walkeri* Theobald, 1905, Mosquitoes of Jamaica, p. 20. Mavis Bank, 5000 ft., (M. Grabham).

Aedes aureostriata (Grabham). Mavis Bank, April, 1906, (M. Grabham).

Aedes aurites (Theobald). Newcastle, July.

Hæmogogus equinus Theobald. Kingston, July 8, 1903, (M. Grabham).

Orthopodamyia waverleyi (Grabham). Waverley Estate, Sept. 1, 1903, (M. Grabham).

Uranotænia socialis Theobald. Rockfort, near Kingston, April 1906, (M. Grabham).

Uranotænia lowii Theobald. Kingston, (M. Grabham).

Anopheles albimanus Wiedemann. *Cellia albipes* Theobald. 1905, Mosquitoes of Jamaica, p. 15. Kingston, Nov. to March. (M. Grabham).

Anopheles vestitipennis Dyar and Knab. Spanish Town, Jan. 1910, (Dr. Neish).

Anopheles maculipes (Theobald). *Arribalzagia maculipes* Theobald. 1905, Mosquitoes of Jamaica, p. 13. Folly Point; Port Antonio; Morant Bay, (Theobald).

Anopheles grabhamii (Theobald). *Cyclolepteron grabhamii* Theobald, 1905, Mosquitoes of Jamaica, p. 17. Liguanea Plain. Kingston, March, April, and May, (M. Grabham); Montego Bay. March, (Grossbeck).

Anopheles crucians Wiedemann. Spanish Town, Jan. 1910. (Dr. Neish).

Anopheles punctipennis (Say). Port Antonio? Jamaica? Its occurrence in Jamaica is questioned, see Mosquitoes of North America, IV, p. 1014.

Anopheles argyrotarsis Theobald, 1905, Mosquitoes of Jamaica, p. 14. Rockfort near Kingston, Nov.-March bred by Dr. Grabham, (Theobald). Its occurrence in Jamaica is questioned by Mr. Knab.

MYCETOPHILIDÆ

Macrocera concinna Williston. Liguanea Plain, Kingston, Nov., (Brues).

Mycetophila pallida, new species

Head, antennæ, thorax, abdomen, and legs light yellow, the first and second abdominal segments and the extreme base of the posterior tibiæ, slightly brownish, scutellum with four long black bristles; the prominent bristles of the middle and posterior tibiæ black, posterior metatarsi as long as all of the following joints together; wings strongly tinged with yellow. Length, 3 mm.

Liguanea Plain, near Kingston, Dec., (Brues).

In the light yellow color of the body and wings it resembles *M. punctata* Say in miniature.

Lela sp. One specimen. Liguanea Plain, Kingston, Dec., (Brues).

Sciara delectata Williston. Cinchona, Feb. 29, (Grossbeck).

CECIDOMYIDÆ

Mycodiplosis coccidivora Felt, 1911, Journ. Econ. Ent., IV, p. 549. "Reared by Prof. T. D. A. Cockerell from the ovisac of *Pulvinaria urbicola* taken on *capsicum* at Kingston, Jamaica, W. I. and labeled *Diplosis coccidarum* Ckll. This is very different from what we take to be the true *Diplosis coccidarum* Ckll., a species reared from *Dactylopius coccidarum*" (Felt).

Catocha sp.? Port Antonio.

Asphondylia sicca Felt. Infests fruit of *Phyllanthus distichus*, the Otaheite gooseberry, (Dr. M. Grabham).

SIMULIDÆ

Simulium antillarum Jennings, 1915, Proc. Ent. Soc., Wash., XVII, p. 200. Hope River near Kingston and Roaring River close to the Falls, Sept. 1913, (A. H. Jennings).

BIBIONIDÆ

Dilophus orbatus (Say). Cinchona, Feb. 24, (Grossbeck).

The posterior cross-vein in this species is often obsolete or wanting.

Dilophus venulatus, new species

MALE.—Head dark brown, shining, proboscis dull brown, nearly as long as the head, palpi and antennæ black. Thorax including the pleura yellow, shining, with a broad black, shining, dorsal strip extending from the collar to and over the scutellum, a row of black spines on the collar and at the transverse suture. Abdomen yellow, with broad posterior bands of black on each segment; on the venter these are obsolete or wanting. Legs yellow, tip of the anterior femora, the three sets of spines on anterior tibiæ, tips of the middle femora and tibiæ, outer half of the posterior femora, tips of the posterior tibiæ, tips of the first three and all of the other joints of all the tarsi, black. The posterior femora clavate. Halteres black. Wings hyaline, veins and stigma dark brown. Length, 3 mm.

One specimen, Newton, 3000 ft., Jan. 1912, (Brues).

Plecia rufithorax Walker. "Jamaica," (Walker). This is probably the *P. collaris* Fabr.

RHYPHIDÆ

Rhyphus dolorosus Williston. Newton, 3000 ft., Jan., (Brues). Yallahs Valley, Blue Mts., Feb., 27, (Grossbeck). Resembles superficially both *R. fenestralis* Scop. and *R. alternatus* Say, but differs in the markings on the wings and in having the two basal joints of the antennæ yellow.

STRATIOMYIDÆ

Hermetia illucens (Linné). Port Antonio, April; Liguanea Plain, Kingston, (Brues).

Macrosargus alchidas (Walker). Port Antonio, April-May.

Macrosargus bagosas (Walker). "Jamaica," (Walker).

Microchrysa bruesi, new species

MALE.—Face and vertical triangle green, frontal triangle small, whitish, palpi and antennæ yellow, aristæ blackish. Thorax and scutellum a bright metallic green with a yellow line extending from the humeri to the base of the wings, postalar callosities reddish. Abdomen and halteres dark fulvous yellow. Legs light yellow. Wings hyaline, veins light brown, stigma yellow. Length, 3 mm.

FEMALE.—Front broad, metallic bluish green. Abdomen greenish yellowish at the base, venter yellow. Length, 2.5 mm. In other respects resembling the male.

Holotype, Liguanea Plain, Kingston, Nov.-Dec., (C. T. Brues). Allotype, Rockfort near Kingston, April, (C. W. Johnson). Paratype, British Guiana, Feb., received from Dr. A. S. Melander.

Cyphomyia marginata Loew? ?*Cyphomyia* n. sp.. Williston, 1885, Can. Ent., XVII, p. 128, Jamaica.

I am referring Williston's "*Cyphomyia* n. sp." doubtfully to this species. It agrees in every respect with the description except that he

does not mention the white pile on the thorax and abdomen. Could the specimens have been denuded, or had they been in alcohol? I wrote to Prof. S. J. Hunter to see if any of the five specimens were in the Museum of the Kansas University but they were not. He kindly sent me, however, a specimen from San Domingo which Dr. Williston had also determined as *Cyphomyia* sp. and which is *C. marginata* Loew. It is the only species of the genus to my knowledge having a red scutellum.

Neorondania chalybea (Wiedemann). *Clitellaria anchialus* Walker, List, part 3, p. 522; var. of *Clitellaria chalybea* Wied. (?), Walker, List, part 4, p. 1157. "Jamaica," (Walker).

Nemotelus flavicornis Johnson. Kingston, April 1891. Type locality.

Oxycera liburna Walker. "Jamaica," (Walker).

Pachygaster pulcher Loew. Mandeville, (Cockerell), U. S. Nat. Mus.

Psephiocera Enderlein, 1914, Zool. Anz., XLIII, p. 300.

Psephiocera metzi, new species

Vertex and front shining black when viewed from above, a front view of the latter shows the sides widely margined with a silvery pollen, face silvery white, antennæ yellow, the third joint short, round, with five annulations, the basal and terminal the larger, base of third joint brown, arista black, subterminal, and a little larger than all the antennal joints together. Thorax black, with three stripes of shining yellowish white tomentum, also a large patch of the same colored tomentum between the humerus and the base of the wing, at the base of the scutellum, and in a certain light a vertical stripe on the middle of the pleura. The edges of the acute scutellum are very finely serrated. Abdomen black with spots of whitish tomentum on the third and fourth segments and a central spot on the fifth, the middle spot on the third segment is faint and only seen in certain lights. Legs and halteres light yellow. Wings hyaline, third vein with an anterior branch. Length, 2.5 mm.

One specimen, Port Antonio, March 30, 1915, (Dr. C. W. Metz). Type in the author's collection.

To this genus belongs the *Cynipimorpha minuta* Williston, of Mexico, for which Malloch proposed the genus *Eucynipimorpha* (1915, Ann. Ent. Soc. Amer., VIII, p. 312). In *P. minuta* the entire thorax is covered with yellowish tomentum. The types of the genus *P. flavipes* Enderlein, from southern Brazil, also has the thorax covered with yellow tomentum, but black on the scutellum, the pleura is shining black, without tomentum.

RHAGIONIDÆ (LEPTIDÆ)

Pheneus tibialis Walker. *Arthrostylum fascipennis* Williston, 1895, Kan. Univ. Quart., IV, p. 108. "Jamaica," (Walker).

Chrysopilus jamaicensis Johnson. Port Antonio, April-May.

TABANIDÆ

Chrysops costatus (Fabricius). Port Antonio, April-May; Kingston, Sept. 11 and Nov. 18, (Townsend); Liguanea Plain, Dec., (Brues); Montego Bay, March 3-11, (Grossbeck).

Tabanus alene Townsend, 1895, Trans. Amer. Ent. Soc., XXII, p. 59. "Bath (Mrs. E. M. Swainson), one female. Type in collection" (Townsend).

Tabanus townsendi, new name

T. angustifrons Townsend, 1895, Trans. Amer. Ent. Soc., XXII, p. 59, *non* Macquart, 1847.

"Jamaica. Two females. One from Cinchona (5000 ft.) Aug. 1893, W. Fawcett. A small species" (Townsend).

Tabanus filiolus Williston. ? *T. rufiventris* Macquart, 1838. Dipt. Exot., I, part 1, p. 141, *non* Fabricius, 1805; *T. filiolus* Williston. Biologia, Dipt. 1, p. 261.

Macquart's species was recorded from Jamaica by Walker. The name being preoccupied, Williston gave the above name to a specimen from Yucatan. The synonymy is therefore doubtful. A specimen from Montego Bay, March 5, (Grossbeck), seems to agree with Macquart's brief description.

Tabanus lucidulus Walker. One specimen collected by Mrs. Geo. L. Chaney at Hollymont, near Ewerton. The brown wings with hyaline spots seem to distinguish readily this interesting species.

BOMBYLIIDÆ

Spogostylum œdipus (Fabricius). Kingston, April.

Spogostylum gideon (Fabricius). "a Var. ? abdomen all black. Jamaica." (Walker).

Hyperalonia hela (Erichson). *Anthrax hela* Erichson in Schomburgk's Reise in Brit. Guiana. *Exoprosopa albiventris* Macquart, 1848. Dipt. Exot. Suppl., III, p. 33, Tab. 3, fig. 8; *non* Macquart, 1838. *loc. cit.*, I, part 2, p. 39, Tab. 18, fig. 10; *non* Thompson, 1868. *Exoprosopa albiventris* Van der Wulp, Tijdsch v. Ent., XXIV, p. 164.

Tab. 15, fig. 11. The law of priority prevents the use of *H. albiventris* Van der Wulp as suggested by Osten Sacken and necessitates the adoption of *H. hela* Erichson. A specimen taken at Morant Bay, April 17, was inadvertently referred to *H. cerberus* in my previous list. I have also a specimen from the Caura Valley, Venezuela, collected by Mr. S. M. Klages.

Hyperalonia proserpina (Wiedemann). *Exoprosopa cerberus* Macquart, 1840, Dipt. Exot., II, part 1, p. 38, Pl. xvi, fig. 5, *non* Fabricius 1794. Kingston, April; Bath, (Mrs. Swainson).

Hyperalonia gargantua Knab, 1915, Insecutor Inscitiæ Menstruus, III, p. 49. St. Elizabeth, Santa Cruz, Mts., altitude 1500 ft., Oct. 14, 1899, (Taylor).

Exoprosopa parva Loew. Rockfort near Kingston, April.

Exoprosopa ignifera Walker. *Anthrax ignifera* Walker, 1849, List, II, p. 243. *Exoprosopa pueblensis* Jaennicke, 1867, Neue Exot. Dipt., Abhdl. d. Senckenb. Ges., VI, p. 342, Pl. xlv, fig. 21. *Exoprosopa eremita* Osten Sacken, 1877, Western Dipt., 236. "Jamaica," Walker.

There seems to be no doubt regarding the above synonymy. Florida and Colorado specimens both agree with Walker's description.

Exoprosopa subfascia (Walker). "Jamaica," (Walker).

Villa bigradata (Loew). *Anthrax bigradata* Loew. Rockfort near Kingston, April.

Villa delicatula (Walker). *Anthrax delicatula* Walker. "Jamaica," (Walker).

Villa lateralis (Say). *Anthrax lateralis* Say. Rockfort near Kingston, April.

Villa lucifer (Fabricius). *Anthrax lucifer* Fabricius. Common, Rockfort near Kingston, April; Liguanea Plain, Nov.-Dec., (Brues); Montego Bay, March 2 and 15, (Grossbeck).

Villa trimaculata (Walker). *Anthrax trimacula* Walker. Kingston and Port Antonio, April-May; Annotta Bay, May; Liguanea Plain, Nov.-Dec., (Brues).

Bombylius plumipes Drury. "Jamaica," (Drury).

Geron senilis (Fabricius). Kingston, April; Montego Bay, March 4.

Geron rufipes Macquart. Liguanea Plain, Kingston, Nov.-Dec., (Brues).

THEREVIDÆ

Psilocephala obscura Coquillett. Kingston, April.

ASILIDÆ

Leptogaster clavipes Johnson, 1897, Ent. News, VIII, p. 120.
L. longipes Johnson, 1894, Proc. Acad. Nat. Sci., Phila., p. 273, non Walker, 1859. Port Antonio, April.

Leptogaster pictipes Loew. Liguanea Plain, Kingston, Nov.-Dec., (Brues).

Plesiomma indecora Loew. [redacted] ston, April; Morant Bay, May 17.

Cerotainia macrocera Say. [redacted] naicensis, new variety

The difference between this and the typical form was briefly referred to in my previous paper. While additional material proves *C. macrocera* to be extremely variable in size and venation, there remain a few characters which seem to separate the island form. The entire insect is a dark smoky-blue, not black, the long hairs of the face are dark brown or black and the yellow ornamentation of the thorax more dense. The veins forming the second posterior cell are practically parallel, in only one of the five specimens is there a marked convergence near the margin. On the other hand, four out of eleven specimens of *C. macrocera* from various parts of the United States, have the second posterior cell closed in one or both wings, one has an adventitious vein near the anterior cross-vein and another a cross-vein in the submarginal cell. The vein dividing the third and fourth posterior cells, often prominent in the typical *macrocera*, is wanting or only indicated by a slight stub.

Port Antonio, April and May. Holotype, allotype, and one paratype in the author's collection; two paratypes in The Amer. Museum of Nat. History.

Ommatius saccas Walker. Port Antonio, April and May. This seems to be a good species readily distinguished from *O. marginellus* Fabricius by the male having a simple, not thickened costa.

Erax haloesus Walker. Bath, (Mrs. E. M. Swainson). This species seems to be distinct from *E. rufitibia* Macquart.

• **Erax stylatus** Fabricius. *Erax invarius* Walker. "Jamaica," (Walker).

DOLICHOPODIDÆ

Psilopus chrysoprasius Walker. Common Port Antonio, April-May; Liguanea Plain near Kingston, Nov.-Dec., (Brues).

Psilopus caudatus Wiedemann. Hope Gardens, Feb. 22; Montego Bay, March 2.

Psilopus jucundus Loew. Port Antonio, April-May; Liguanea Plain near Kingston, Nov.-Dec., (Brues).

Psilopus suavium Walker. "Jamaica," (Walker).

Psilopus flavicornis (Aldrich). Port Antonio, Feb. 21; Montego Bay, March 13, 1911.

Chrysotus barbatus (Loew). Montego Bay, March 6, (Cushman).

Chrysotus picticornis Loew. Montego Bay, March 6, (Cushman).

Chrysotus sp. Kingston, April.

Plagioneurus univittatus Loew. Hope Gardens, Feb. 22, 1911, (Grossbeck). Amer. Mus. Nat. History.

Paraclius arcuatus Loew. "Jamaica," (Aldrich).

EMPIDIDÆ

Drapetis flavicornis Melander. *D. flavicornis* Melander, 1918, Ann. Entom. Soc. Amer., XI, p. 193. "Jamaica," (Melander).

Elaphropeza bacia (Walker). *Platypalpus bacia* Walker, 1849, List Dipt. Ins., III, p. 510. "Jamaica," (Walker).

Elaphropeza flavida (Williston). *Drapetis flavida* Williston, 1896, Trans. Ent. Soc., London, III, p. 308, Pl. II, fig. 86. Hope Garden, Feb. 22; Catadupa, March 9, 1911.

Elaphropeza simplicipes Melander, 1918, Ann. Ent. Soc. Amer., XI, p. 212. Montego Bay, March 6, (J. A. Cushman); Balaclava.

Elaphropeza upsilon Melander, 1918, Ann. Ent. Soc. Amer., XI, p. 214. Jamaica, (Brues).

Hybos electus Melander. Montego Bay, Feb. 25, (Cushman); Liguanea Plain, Nov.-Dec., (Brues).

Lamprempis viridis (Coquillett). *Hilara viridis* Coquillett, Revis. Empid., p. 395. Kingston.

PHORIDÆ

BY CHARLES T. BRUES

Paraspiniphora scutellata Brues *jamaicensis*, new subspecies

FEMALE.—So similar to *P. scutellata* Brues¹ in habitus, color, and in most structural details, that it cannot be recognized as a distinct species. It differs in having the lateral scutellar bristles very much reduced in size, and in having only two serial

¹Trans. Amer. Ent. Soc., XXIX, p. 344.

bristles on the hind edge of the hind tibiae in addition to the pair at the basal third, one of these at the middle and the other at the apical third. The pleurae and legs are fusco-piceous and the antennae and palpi clear honey-yellow. Otherwise similar to the typical form even to the white spot on the scutellum.

MALE.—Front barely higher than wide, narrowed, below, lowest pair of bristles very close together; lowest row of four slightly curved, the median pair farther from each other than from the adjacent lateral one; upper row slightly curved, its bristles equidistant, the lateral ones next to the eye. Propleura hairy, with two large bristles near the spiracle and a bunch of four or five next the coxa, mesopleura hairy above, with a bristle near the upper posterior angle. Sixth abdominal segment, but not the second, elongated.

Type from the Liguanea Plain, near Kingston, Jamaica, Nov.-Dec. 1911 (Bruce).

This species has been placed in *Paraspiniphora* by Malloch, although it approaches *Dohrniphora* in the chaetotaxy of the middle tibia, except that the subapical bristle is strong and perhaps a little farther from the apex than in typical *Dohrniphora*.

Dohrniphora dispar Enderlein. Balacava, Jamaica, (R. Thaxter). The species was lately described by Enderlein¹ from Santa Catalina, Brasil. The antennae of the Jamaican male are somewhat smaller than is indicated in Enderlein's description; otherwise it agrees very well.

Aphiochæta spinifemorata Malloch. Proc. U. S. Nat. Mus. XLIII, p. 465 (1912). Type locality Mandrilla, Jamaica, (T. D. Cockerell). This may be the *Phora scalaris* Loew recorded by Cockerell from Mandeville, Jamaica. Cockerell indicated that the specimen was in the U. S. National Museum and I know of no town in Jamaica by the name of Mandrilla which is likely a mistake for Mandeville.

Aphiochæta scalaris (Loew). Liguanea Plain, near Kingston, Jamaica, Nov.-Dec. 1911, (Bruce).

Paraphiochæta picta Lehmann, *fasciiventris*, new variety

Differs from the typical form only in having the abdomen entirely black above, with each segment narrowly margined with pale yellow at apex and in being generally darker, the front black except below, and the dorsum of the thorax except on the margins. The front is also distinctly, though not noticeably higher than wide. The wings show no yellowish tinge, and the venation is very dark; halteres considerably infuscated.

Type from Liguanea Plain, near Kingston, Jamaica, Nov.-Dec. 1911, (Bruce).

Although quite different in color from the typical *picta*, this form is structurally almost identical.

¹1912, Stettiner Ent. Zeitg., p. 20.

²1894, Proc. Nat. Sci. Philadelphia, p. 420.

Chonocephalus jamaicensis Brues, Psyche, XXII, p. 102 (1915).
Type locality Williamstown, Jamaica, (R. Thaxter).

PIPUNCULIDÆ

Pipunculus albiseta Cresson. Montego Bay, March 15, (Grossbeck).

Pipunculus insularis Cresson. Liguanea Plain, Kingston, Nov.-Dec., (Brues).

Pipunculus cressoni, new species

Face and occiput covered with silvery white pollen, antennæ yellow, third joint moderately acuminate, tip white, arista black, base yellow. Thorax black, brownish pollinose, lateral stripe and pleura whitish pollinose, scutellum and metanotum black. Abdomen brown, fifth segment black (in one specimen the fourth segment is also somewhat blackish), genitalia and the entire venter yellow. Legs and halteres entirely yellow. Wings hyaline, with a slight brownish tinge, stigma very small, venation normal. Length, 3 mm

Holotype, Montego Bay, March 6, collected by Dr. J. A. Cushman.

Paratype, Liguanea Plain, near Kingston, Nov.-Dec. 1911, collected by Prof. C. T. Brues. Types in the author's collection. Dedicated to Mr. E. T. Cresson, Jr. who has done so much to further our knowledge of the Pipunculidæ

Pipunculus jamaicensis, new species

Front, face and occiput whitish pollinose, antennæ brown, tip of the third joint whitish, aristæ black. Thorax and scutellum black, brownish pollinose, pleura and metanotum grayish. Abdomen black, the base of all the segments opaque with broad, grayish, subshining, posterior margins of the first segment with white pollinose triangles narrowly separated dorsally. Legs yellow, all of the femora broadly banded with black. Halteres yellow. Wings brownish hyaline, ultimate section of the fourth vein with a short appendage. Length, 4 mm.

One specimen Liguanea Plain, near Kingston, Dec. 1911, collected by Prof. C. T. Brues. Type in author's collection.

SYRPHIDÆ

Microdon violens Townsend. *M. violens* Townsend, 1895, Trans. Amer. Ent. Soc., XXII, p. 34. "Jamaica," (Bowrey).

Chrysotoxum nigrum (Fabricius). "Jamaica," (Fabricius).

Lepidostola calopus (Loew). *Lepidomyia calopus* Loew, 1864, Cent., V, p. 38. *Lepromyia calopus* Williston, 1886, Synop. N. A. Syrphidæ, p. 31. One specimen, Port Antonio, April. Although *Lepromyia* was published the same year—1886, Williston acknowledges the priority of *Lepidostola* Mik.

Baccha clavata (Fabricius). Rockfort near Kingston, April; Bath, (E. M. Swainson); Constant Spring, Dec. 6, C. B. Taylor's collection (Townsend); Liguanea Plain, Nov.-Dec., (Brues); Montego Bay, March, (Cushman).

Baccha sagittifera Austen. Cinchona, 5000 ft., June, (Austen).

Ocyptamus antiphates (Walker). *Syrphus antiphates* Walker, 1849, List. Dipt. Brit. Mus., III, p. 589. "Jamaica," (Walker).

Ocyptamus dimidiatus (Fabricius). Kingston, March 18, in coll. C. B. Taylor, (Townsend).

Ocyptamus fuscipennis (Say). Jamaica, (Bowrey).

Ocyptamus fuscipennis, var. **fascipennis** Macquart. Kingston, April 12, coll. C. B. Taylor, (Townsend).

Ocyptamus iris Austen. Cinchona, 5000 ft., June, (Austen).

Ocyptamus latiuscula Loew. Kingston, April; Liguanea Plain, Dec. and Newton, 5000 ft., Jan., (Brues).

Syrphus ribesii (Linné). Cinchona, 5000 ft., Jan., (Brues).

Allograpta obliqua (Say). Newton, 3000 ft., Jan., (Brues).

Allograpta obliqua var. **securifera** (Macquart). One specimen Cinchona, 5000 ft., Jan., (Brues). This differs from the typical form in having the yellow subdorsal lines and lateral spots on the fourth and fifth segments connected, thus forming hatchet-shaped markings. The black dorsal line on these segments is also much wider. It may be proved to be a good species but more material is necessary.

Toxomerus arcifera (Loew). *Mesograpta arcifera* Loew, of the previous list. Common at Port Antonio and Kingston, April; Liguanea Plain, Nov. and Dec., (Brues); Montego Bay, March 6, (Cushman).

Toxomerus pictus (Macquart). *Mesogramma pæcilogaster* Loew, 1865, Cent., VI, p. 51. Liguanea Plain, Nov.-Dec., (Brues); Montego Bay, March, (Cushman).

Toxomerus duplicatus (Wiedemann). Kingston, April.

Toxomerus subannulatus (Loew). Kingston and Port Antonio. April-May; Liguanea Plain, Nov.-Dec. and Newton, 3000 ft., Jan., (Brues); Montego Bay, March 6, (Cushman).

Toxomerus laciniosus (Loew). Liguanea Plain, Kingston, Nov.-Dec., (Brues).

Toxomerus sp. One specimen, Montego Bay, March, (Cushman).

Volucella abdominalis Wiedemann. *V. spiniger* Cockerell (*non*

Wiedemann), Journ. Inst. Jamaica, I, p. 259, British Museum. "Though the specimens seem to have been determined at the British Museum, still I am confident that they are *abdominalis* Wied. and not *spinigera* Wied." (Townsend, 1895, Trans. Amer. Ent. Soc., XXII, p. 39).

Volucella eugenia Williston. *V. purpurascens* Johnson, 1894, Proc. Acad. Nat. Sci. Phila., p. 276, (*non* Loew). Kingston, April; Newton, 3000 ft., Jan., (Brues).

Volucella haagii Jaennick. "Jamaica," (Bowrey). Kingston, March 10, C. B. Taylor's Coll., (Townsend).

Volucella obesa (Fabricius). Common Port Antonio, April-May; Kingston, (Townsend); Liguanea Plain, Dec., (Brues).

Volucella pallens Wiedemann. *V. sexpunctata* Loew, 1861, Wien. Ent. Monatsch., V, p. 38. Port Antonio, April; Bath, (Townsend); Liguanea Plain, Dec. and Newton, 3000 ft., Jan., (Brues).

Volucella picta Wiedemann. Liguanea Plain, Dec., (Brues).

Volucella vacua (Fabricius). "Jamaica," (Bowrey); Kingston, C. B. Taylor's Coll., (Townsend).

Eristalis albifrons Wiedemann. Common Port Antonio, April-May.

Eristalis atrimanus Loew. Port Antonio, April; Bath, (Townsend).

Eristalis cubensis Macquart. Port Antonio, April.

Eristalis vinetorum Fabricius. (*E. uwarum* Walker). Common, Port Antonio, April-May; Bath, (Swainson).

Eristalis lateralis Walker. "Jamaica," (Walker).

Meromacrus cinctus (Drury). *Eristalis pinguis* Fabr., 1805, Syst. Antl., p. 233. *Milesia ania* Walker, 1849, List Dipt. Brit. Mus., III, p. 564. *Pteroptila cincta* Johnson, 1894, Proc. Acad. Nat. Sci., Phila., p. 277. Common, Port Antonio, April-May; Bath, (Swainson); Cinchona, 5000 ft., Jan., (Mrs. C. T. Brues).

Ceriodes daphnæa (Walker). *Ceria daphnæa* Walker, 1847, List Dipt. Brit. Mus., III, p. 537. Rock Fort, near Kingston, April, Port Antonio, April-May. In motion this fly closely resembles a wasp (*Polybia* sp.).

CESTRIDÆ

Gastrophilus intestinalis (DeGeer). *Gastrophilus equi* (Clark). The Horse Botfly. Cinchona, 5000 ft., (W. Harris); two females, August, (Townsend).

Gastrophilus pecorum (Fabricius). "Jamaica," (Walker).

TACHINIDÆ

Gymnoclytia immaculata (Macquart). Liguanea Plain, Dec., (Brues).

Trichopoda [redacted] (s). Cinchona, 5000 ft., Jan., (Brues).

Anisia var. [redacted] Port Antonio, April 1891.

Hypostena [redacted] sis [redacted] l). Kingston, April 1891.

Hypostena [redacted] [redacted] arch 2, 1911, (Grossbeck).

Leskia au [redacted] Kingston; Port Antonio, April 1891; Hollymont near Ewerton (Geo. L. Chaney).

Leskiomima tenera (Wiedemann). Hollymont near Ewerton, (Mrs. Geo. L. Chaney).

Leucostoma senilis (Townsend). Liguanea Plain, Dec., (Brues).

Cestrophasia punctata (Coquillett). Liguanea Plain, Dec., (Brues).

Senotainia rubriventris Macquart. Kingston, April 1891.

Senotainia trilineata (Van der Wulp). Newton, 3000 ft., Jan., (Brues).

Plagia parva, new species

FEMALE.—Face and front whitish pollinose, frontal stripe dark brown, about one-third the width of the front near the base of the antennæ becoming slightly narrower toward the ocelli, with about six frontal and three fronto-orbital bristles, vertical and ocellar bristles prominent, antennæ black, reaching the oral margin, the third joint about double the length of the first and second together, palpi yellow. Thorax grayish pollinose, with four narrow black stripes, the post-alar and scutellar bristles very large. Abdomen grayish pollinose, the segments margined posteriorly with black. Legs black. Wings hyaline, the costa, first, and third vein as far as the cross-vein bristly. Squamæ white. Length, 5 mm.

Two specimens, Liguanea Plain, near Kingston, Dec. 1911 (Brues).

Belvosia bicincta (Desvoidy). Kingston, (Cockerell).

Belvosia ferruginosa Townsend. Bath, (E. M. Swainson). — Bred from a lepidopterous chrysalis; one male, (Townsend).

Belvosia unifasciata (Desvoidy). Port Antonio, April 1891.

Ocyptera carolinæ (Desvoidy). *O. dotades* Walker, 1849, List Dipt. Brit. Mus., IV, p. 694. Port Antonio, April 1891.

Carcellia lagosæ (Townsend). *Exorista lagosæ* Townsenn, 1891, Ent. News, II, p. 159. Mandeville. Bred from a red *Halesidota*, (E. S. Panton).

Sturmia distincta (Wiedemann). *Masicera protoparcis* Townsend, Journ. Inst. Jamaica, I, p. 70. Bred from *Protoparce jamaicensis*.

Sturmia fraudulenta (Van der Wulp). Kingston, April; Holymont near Ewerton, (Mrs. Geo. L. Chaney).

Sturmia (?) **subvaria** (Walker). *Tachina subvaria* Walker, 1856, Dipt. Saund., p. 299. Kingston and Port Antonio, April 1891. Determined by Coquillett.

Tachina (?) **hirta** (Drury). "Jamaica."

Blepharipeza jurinoides Townsend. Cinchona, 5000 ft., (W. Faucett).

Blepharipeza nigrisquamis Townsend. Bath, (Mrs. Swainson); Port Antonio, April 1891.

Blepharipeza (?) **breviventris** (Wiedemann). *Tachina breviventris* Wiedemann, 1828, Auss. Zw. II, p. 297. Jamaica, (Walker).

Winthemia quadripustulata (Fabricius). Kingston and Port Antonio, April 1891; Newton, 3000 ft., Jan., (Brues).

Metopia leucocephala (Rossi). ? *Ophelia xychus* Walker, 1849, List Dipt. Brit. Mus., IV, p. 770. Jamaica, (Walker).

Gonia pallens Wiedemann. *G. angusta* Walker, 1849, List Dipt. Brit. Mus., IV, p. 798. Common, Port Antonio, April-May 1891. Liguanea Plain, Nov.-Dec., (Brues).

Gonia crassicornis (Fabricius). Rock Fort, near Kingston.

Trichophora macrocera (Wiedemann). *Elachipalpus macrocera* Wiedemann of the previous list. Port Antonio, April 1891; Liguanea Plain, Nov., (Brues).

Hystrieciella aurifrons Townsend. "Jamaica," (Townsend), 1915, Insecutor Inscitiæ Menstruus, III, p. 95.

Hystriicia epileuca (Walker). *Jurinia epileuca* Walker of the previous list. "Jamaica," (Walker).

Archytas basifulva (Walker). *Echinomyia basifulva* Walker, List Dipt. Brit. Mus., IV, p. 725. *Jurinia amethystina* Johnson (non Macquart), 1894, Proc. Acad. Nat. Sci. Phila., p. 277.

This species is closely related to *A. analis* Fabricius of which *A. amethystina* Macquart is a synonym. It can be readily separated however by the much darker scutellum and terminal abdominal segment and the grayish not yellowish pollinose thorax. Port Antonio, April; Cinchona, 5000 ft., and Newton, 3000 ft., Jan., (Brues).

Archytas piliventris (Van der Wulp). Port Antonio and Kingston, April; Liguanea Plain, Nov., (Brues).

Pseudohystericia exilis Townsend. Cinchona, (Cockerell); Bath, (Mrs. Swainson); Newton, 3000 ft., Jan., (Brues); Hollymont near Ewerton, (Mrs. Chaney).

DEXTERÆ

Prosenoides flavipes Coquillett. Montego Bay, March 6, (Cushman).

Rhynchodexia rufianalis Van der Wulp. Port Antonio and Kingston, April 1891.

Leptoda thomæ (Wiedemann). *Dexia thomæ* Wiedemann, Auss. Zw., II, p. 379. Jamaica, (Walker).

Thelairodes cinereicollis Van der Wulp. Yallahs Valley, Blue Mts., Feb. 27, (Grossbeck).

Chætona sp. Kingston, April. One female. A small species resembling *C. nitens* Coq.

Stenodexia foxii, new species

MALE.—Front with a broad, blackish frontal stripe, frontal orbits and the entire face yellow, antennæ black, aristæ conspicuously pubescent, proboscis black, palpi small, yellow. Thorax black, two subdorsal lines, a short line above the base of the wing, and pleura grayish pollinose. Scutellum black, apex gray, four large marginal bristles. Abdomen black, a spot on each side of the second and a broad band at the base of the third to fifth segments grayish pollinose, third segment with four, and the fourth and fifth each with six marginal macrochaetae. Legs dark brown, tarsi blackish. Wings light brown, the small cross-vein at the middle of the discal cell. Opening of the first posterior cell narrow, squamæ white, halteres yellow. Length, 4 mm.

FEMALE.—Similar to the male.

Two specimens, Port Antonio, April 1891.

Allied to *S. albocincta* Van der Wulp, but the smaller size, prominent thoracic stripes, and three light bands on the abdomen readily separate this species. It is dedicated to Mr. William J. Fox, my companion on the collecting trip when these specimens were taken.

SARCOPHAGIDÆ

Phrissopodia sp. Bath; bred from a snail, Townsend, Journ. Inst. Jamaica, I, p. 315.

Sarothromyia femoralis (Schiner). Kingston, April 1891; Port Royal, Feb. 23, 1911, (Amer. Mus. Nat. Hist.).

Sarcophagula occidua (Fabricius). *S. imbecilla* Van der Wulp, 1896, Biol. Cent. Amer., II, p. 289, Pl. VII, fig. 2. Kingston and Port Antonio, April 1891; Liguanea Plain, Nov.-Dec., (Brues); Port Royal, Feb. 23, (Amer. Mus. Nat. Hist.).

Sarcophilodes sp. Moneague, (Townsend).

Sarcophaga parkeri Aldrich. "Jamaica," (Klages).

Sarcophaga (Ravinia) quadrisetosa Coquillett. Liguanea Plain, Kingston, "Nov.-Dec." (Brues).

Sarcophaga helcis Townsend. *Helicobia helcis* Coq., 1895, Proc. Acad. Nat. Sci. Phila., p. 307. Kingston, April 1891; Hollymont near Ewerton, (Mrs. Chaney); Liguanea Plain, Nov.-Dec., (Brues).

Sarcophaga peltata Aldrich. ? *Sarcophaga incesta* Walker, 1852, Dipt. Saund., p. 324. An unrecognizable species, (Aldrich). Port Antonio and Kingston, April 1891; Hollymont near Ewerton, (Mrs. Chaney); Liguanea Plain, Nov.-Dec., (Brues).

Sarcophaga sternodontis (Townsend). *Sarcodexia sternodontis* Townsend, 1892, Journ. Inst. Jamaica, I, p. 105. Bred from a cerambycid beetle (*Sternodontes damicornis*), also from a scorpion (*Centrurus edwardsii*). Montego Bay, March 6, (Cushman); Hollymont near Ewerton, (Mrs. Chaney).

Sarcophaga ambriata Aldrich. Port Antonio, Portland, April 1891.

Sarcophaga plinthopyga Wiedemann. Port Antonio and Kingston, April 1891; Hollymont near Ewerton, (Mrs. Chaney); Cinchona, 5000 ft., Jan., (Brues).

MUSCIDÆ

Callitroga macellaria (Fabricius). "Screw-worm fly." *Compso-myia macellaria* Fabricius. Johnson, 1894, Proc. Acad. Nat. Sci., Phila., p. 279. *Chrysomyia macellaria* Aldrich, 1905, Catalogue, p. 517. Common, Kingston, April. Townsend has proposed the generic name *Cochliomyia* for this species, but Brauer and Bergenstamm had a perfect right to adopt *Callitroga* Schiner, MS.

Callitroga (?) turbida (Walker). *Musca turbida* Walker, 1856 Dipt. Saund., p. 336, "Jamaica," (Walker). Probably a synonym of *C. macellaria* Fabricius.

Calliphora punctata (Desvoidy). *Ormia punctata* Desvoidy, 1830, Myodaires, p. 428. "Jamaica," (Macquart).

Pyrellia scapulata Bigot. Common, Kingston and Port Antonio, April-May. The *Lucilia* sp. of my previous list. *Liguanea* Plain, Nov.-Dec., (Brues).

Morellia basalis (Walker). "Jamaica," (Walker). According to Dr. Hough this is probably a synonym of *M. ochryfacies* Rond.

Morellia violacea (Fabricius). Kingston and Port Antonio, April-May.

Musca domestica Linné. The Housefly. Kingston, April. A small form with the basal segments of the abdomen yellowish was described by Macquart as *M. basalaris*.

Stomoxys calcitrans (Linné). The "Biting Housefly." *Liguanea* Plain, Nov.-Dec., (Brues); Montego Bay, March 6, (Grossbeck).

Hæmatobia irritans (Linné). The "Hornfly." *H. serrata* Desvoidy, 1830, Myodaires, p. 398. Montego Bay, March 5, (Grossbeck).

Glinopera scutellata, new species

Front very narrow, stripe black, orbits silvery white, with an even row of bristles from the base of the antennæ of the vertex; face dull yellow, whitish pollinose; antennæ and palpi bright yellow; proboscis and inferior orbits black, the latter whitish pollinose. Thorax black, shining, with five white pollinose stripes, the dorsal and lateral stripes becoming obsolete behind the suture; one post-acrostical and four dorso-central bristles. Scutellum black, the apical third bright yellow, with two large apical bristles. Abdomen black, shining, and in a certain light tessellated with a whitish bloom. Legs black, tips of the femora yellow. Wings a light brownish hyaline; antisquama and squama white, the margin of the latter brownish; halteres light yellow. Length, 4.5 mm.

One specimen, *Liguanea* Plain near Kingston, Nov. 1911, (Brues).

ANTHOMYIDÆ

Ophyra ænescens (Wiedemann). Newton, 3000 ft., Jan., (Brues).

Fannia trimaculata (Stein). Kingston, April, Port Antonio, April.

Mydæa spermophilæ Townsend. Kingston. "One specimen bred Nov. 22, from a young *Spermophila*, probably *S. bicolor* L. Similar

larvæ have been noticed at Cinchona (5000 ft.) in nestlings. They have also been noticed in nightingale, *Mimus orpheus*, nestlings at Duncans, "Jamaica," (Townsend). Newton, 3000 ft., Jan., (Brues).

Spilogaster discreta Van der Wulp. Liguanea Plains, near Kingston, Dec., (Brues). A single female agrees well with the description.

Aricia sp.? Cinchona, Feb. 26, 1911, (Grossbeck). A single female resembling somewhat *A. lucorum* Fall.

Calythea albicincta (Fallen). *Anthomyia albicincta* Fallen of authors. Kingston and Port Antonio, April; Montego Bay, March 3, (Cushman).

Leucomelina pica Macquart. One specimen, Newton, 3000 ft., Jan. 1912, (Brues).

Leucomelina exul (Williston). *Limnophora (Spilogaster?) exul* Williston, 1896, Trans. Ent. Soc. London, part 3, p. 370, Pl. XII, figs. 122, 122a. Kingston and Port Antonio, Apr.; Montego Bay, March 6, (Grossbeck).

There are a number of species found throughout the greater portion of the United States, Mexico, and the West Indies, that clearly resemble each other and, from the various scattered descriptions, it is very difficult to separate them or to tell which one the author really had before him. Their generic position is also a matter of some doubt or discussion, owing to the fact that there are probably more than one species referable to *Leucomelina pica*, the type of the genus. Although Macquart's descriptions and figures are poor, there seems to be little doubt that he had one of the species of this group before him and, since his type is a species of tropical America, I will use this until we have a better knowledge of the number of species and their distribution. I am, therefore, inclined to follow Van der Wulp who reviewed the species in the *Biologia Centrale-Americana*, II, p. 326, 1896.

All of the four species at hand have the third and fourth veins converging, with bristles at the base of the third vein. The species with the prothoracic stripes wanting I am referring to *L. pica*. The other three more closely resemble each other, but seem to be readily separated by the width of the front in the males, the females are more difficult to distinguish.

The specimens from the United States and Mexico agree with *L. narona* Walker, (*L. cyrtoneura* Stein). *L. garrula* Giglio-Tos also seems

to be synonymous from the descriptions, and the figure given by Van der Wulp (Biol. Cent. Amer., Tab. 8, fig. 9.), although Stein separates it on the shorter pubescence of the aristæ (1904, Ann. Mus. Nat. Hung., II, p. 472). The specimens from Jamaica and Cuba represent two species; one is evidently *L. exul* Williston, to which the following cephalic characters as well as the thoracic markings apply. "Eyes narrowly separated below the ocelli; median black stripe of the front expanded triangularly below; orbital margins silvery pollinose." Among the specimens from Havana, Cuba, however, is another species with the front very narrow as in *L. parva* but without the black stripe, the silvery white orbits are united leaving only a small black triangle above the base of the antennæ. The gray and black stripes of the thorax are of almost equal width, the lateral gray stripes slightly interrupted above the base of the wings. It resembles the figure of *Brachyophyra effrons* Giglio-Tos. (Ditt. del Mess., IV, p. 26, fig. 6), but the wider front, plumose aristæ, venation, and the marking on the fourth abdominal segment, readily separate it from that species. This species was received from Prof. Chas. F. Baker when at the Estacion Central Agronomica, the Santiago de la Vegas, near Havana. I apply provisionally the name of *L. cubana* to this species pending the completion of a paper on the Diptera of Cuba.

***Caricea antica* (Walker).** *C. insignis* Stein, 1897, Berliner Ent. Zeitschr., XLII, p. 257. Kingston and Port Antonio, April; Montego Bay, Feb. 28, (Cushman); March 6, (Grossbeck).

***Cœnosia flavipes* Williston.** Yallahs Valley, Blue Mts., Feb. 27; Cinchona, Feb. 25, (Grossbeck). Liguanea Plain, Kingston, Nov., (Brues).

***Cœnosia tenuicornis* Van der Wulp.** Cinchona, Feb. 25, Yallahs Valley, Blue Mts., Feb. 27.

This species was based on a single female. Two males agree closely with the description, except that the second segment of the abdomen lacks a dorsal spot, the black being confined to the posterior margin. Two females taken at the same time and place (Cinchona) have the palpi and antennæ blackish but otherwise agree with the description.

***Cœnosia tibialis* Stein?** Hope Gardens, Feb. 22; Yallahs Valley, Blue Mts., Feb. 27.

The two specimens agree well with a cotype in my collection, but as the specimens are in poor condition, I must question their identity.

CLUSIODIDÆ (HETERONEURIDÆ)

Heteromeria lumbalis (Williston). *Heteroneura lumbalis* Williston, 1896, Trans. Ent. Soc. London, p. 388. Montego Bay, March 4-6, (Cushman).

BORBORIDÆ

Limosina sp. Balaclava and Clarkston, (Thaxter).

SAPROMYZIDÆ

Lonchæa wiedemanni Townsend. *L. nigra* Wiedemann (*non* Meigen). Montego Bay, March 4, (Cushman).

Lonchæa orchidearum Townsend. "One specimen bred March 19 from a flower stem of an orchid (*Oncidium luridum*) brought from Kingston Garden, Feb. 22" (Townsend). Montego Bay, March 2, (Grossbeck).

Lauxania albovittata Loew. Port Antonio, April-May; Liguanea Plain, Nov.-Dec., (Brues); Montego Bay, Feb. 28-March 4, (Cushman).

Sapromyza bipunctata Say. Kingston, April; Liguanea Plain, Nov.-Dec., (Brues).

Sapromyza grata Wiedemann. Liguanea Plain, Kingston, Nov.-Dec., (Brues.)

Sapromyza octopunctata Wiedemann. Kingston, April; Liguanea Plain, Nov.-Dec., (Brues); Montego Bay, March 6, (Cushman).

Sapromyza sordida Wiedemann. Rock Fort, near Kingston, April; Liguanea Plain, Nov.-Dec., (Brues). Montego Bay, Feb. 28-March 4, (Cushman).

Sapromyza sororia Williston. Catodupa, March 9.

Sapromyza cincta Loew. Liguanea Plain, Kingston, Nov.-Dec., (Brues).

Sapromyza sp. Cinchona, Feb. 25. One specimen measuring 5 mm., probably a large form of *S. sordida* Wiedemann.

Physogenna vittata Macquart. Port Antonio, April-May; Montego Bay, March 6, (Cushman); Liguanea Plain, Nov.-Dec., (Brues); Hope Gardens, Feb. 22, and Catadupa, March 4, (Grossbeck).

Physogenna (?) multicolor, new species

Head light yellow, a large, round, shiny, black spot on the center of the face, and a smaller one on the vertex surrounding the ocelli, antennae yellow (third joint wanting). Thorax light brown, shining, humerus and a large oblong spot on the pleura light yellow, these spots are surrounded by two oblique dark brown stripes, two dark brown slightly arcuate stripes extend from the suture to the basal angles of the scutellum, scutellum light yellow, metanotum light brown. Abdomen black, shiny. Legs and halteres light yellow, wings hyaline, with a slight yellowish tinge. Length, 2.5 mm.

One specimen: Montego Bay, March 15, 1911, (Grossbeck). Type in The American Museum of Natural History.

Owing to imperfect antennae I am referring it provisionally to this genus. The facial and pleural markings have a superficial resemblance to *Lauriania flavida* Wiedemann and it may possibly belong to that genus notwithstanding its weak frontal thoracic and scutellar bristles.

Minettia annulipes, new species

FEMALE.—Face grayish pollinose with a brownish spot on the upper angle of the epistoma and at the junctions of the facial and inferior orbits; front grayish with two short stripes slightly diverging above; two frontal and two vertical bristles; first and second joints of the black with black hairs and bristles, third joint yellowish, arista blackish slightly pubescent. Thorax grayish pollinose with lateral and two subdorsal brown stripes, there is also a slight dorsal stripe which does not reach either the anterior or posterior margins; four large dorso-centrals inserted in a black dot and two small post-arcosticals; pleura gray spotted with brown; scutellum gray with four marginal bristles. Abdomen yellowish with blackish bands in the third and fifth, these are divided forming two large spots. Legs light yellow, femora with an apical and submedian ring of black; on the middle femora there is also a basal ring; tibia with a subbasal and apical ring of black; tarsi brownish. Halteres yellow. Wings brownish hyaline, anterior cross vein at the middle of the discal cell. Length, 2.6 mm.

Two specimens. Cinchona, Feb. 25, 26, 1911, (Grossbeck). Holotype and paratype in The American Museum of Natural History.

Resembling *M. quadrilineata* Loew and *M. annulata* Melander, but readily separated by its dark banded legs.

Minettia cineracea (Coquillett). Liguanea Plain, Kingston, Nov.-Dec., (Brues).

ORTALIDÆ

Notogramma stigma (Fabricius). Liguanea Plain, Nov., (Brues); Montego Bay, Feb. 25. (Cushman).

Euxesta annonæ (Fabricius). Kingston and Port Antonio. April; Liguanea Plain, Dec., and Newton 3000 ft., Jan., (Brues); Montego Bay, March 2, and Catadupa, March 9, (Grossbeck).

Euxesta annonæ scutellata, new variety

This differs from the typical *F. annonæ* Fabr. in having the scutellum bright red, femora and tarsi reddish, tibiae black, bluish on the outer side.

Two specimens, Montego Bay, Feb. 25, 1912, (Cushman).

Euxesta costalis (Fabricius). Port Antonio, April; Liguanea Plain, Dec., and Newton, 3000 ft., Jan., (Brues).

Euxesta stigmatias Loew. Port Antonio, April; Montego Bay, March 2.

Euxesta pusio Loew. Liguanea Plain, Dec., (Brues).

Euxesta avala (Walker). *Trypeta avala* Walker, 1849, List Dipt. Brit. Mus., IV, p. 1020. "Jamaica," (Walker).

TRYPETIDÆ

Anastrepha acidusa (Walker). "Jamaica," (Walker).

Anastrepha ocesia (Walker). "Jamaica," (Walker).

Hexachæta dinia (Walker). "Jamaica," (Walker). This may be the same as *H. eximia* Wiedemann.

Aciura insecta (Loew). Common, Port Antonio, April–May. Yallahs Valley, Feb. 29 and Catadupa March 9, (Amer. Mus. Nat. Hist.).

Acidia fallax, new species

FEMALE.—Head, antennæ, thorax, scutellum, and legs dark yellow; abdomen black, somewhat shiny. In color markings the wings resemble those of *A. fratria* Loew (Mon. N. A. Dipt., III, Pl. x, fig. 4), but the cross-veins are nearer each other, the larger of the oblique bands covering both of these, is not sinuous, the middle costal spot is larger and divided, the extreme base of the wing is hyaline, and an irregular hyaline band extends from the costa across the basal and third posterior cells. Length, 4 mm.

Yallahs Valley, Blue Mts., Feb. 27. Type in The American Museum of Natural History.

Ensina picciola (Bigot). *Trypeta humilis* Loew, 1862, Mon. Dipt. North America, I, p. 81. Common, Port Antonio, April–May. Liguanea Plain, Nov.–Dec., (Brues). Yallahs Valley, Feb. 27; Cinchona, Feb. 25; Catadupa March 9, (Amer. Mus. Nat. Hist.).

Tephritis fucata (Fabricius). Common, Rock Fort, near Kingston April.

Tephritis analis (Loew). One specimen, Newton, 3000 ft., Brues.

Euaresta melanogaster (Loew). Port Antonio, April, Montego Bay. Catadupa, March 9, (Amer. Mus. Nat. Hist.). Liguanea Plain, Nov.-Dec., (Brues).

MICROPEZIDÆ

Micropeza producta Walker. Port Antonio, April 1891.

Nerius solitarius, new species

Front dark brown, narrowly margined with yellow, one vertical and two orbital
the projecting portion of the head blackish, face white, proboscis yellow,
of the ante other two, the second black above,
below, all of t a black, thickened and yellowish at
e, as long thick grayish pollinose above, with a
median, ax brown, with a wide gray dorsal
e containing two narrow anteriorly and uniting near the scutellum
there are three prominent bristles, s um gray with the discal portion red-
dish, pleura brown, grayish pollinose, an- oxe light yellow, the same color pre-
vailing over the entire prosternum. brownish, the sides below narrowly
margined with light yellow. Legs 3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-100-101-102-103-104-105-106-107-108-109-110-111-112-113-114-115-116-117-118-119-120-121-122-123-124-125-126-127-128-129-130-131-132-133-134-135-136-137-138-139-140-141-142-143-144-145-146-147-148-149-150-151-152-153-154-155-156-157-158-159-160-161-162-163-164-165-166-167-168-169-170-171-172-173-174-175-176-177-178-179-180-181-182-183-184-185-186-187-188-189-190-191-192-193-194-195-196-197-198-199-200-201-202-203-204-205-206-207-208-209-210-211-212-213-214-215-216-217-218-219-220-221-222-223-224-225-226-227-228-229-230-231-232-233-234-235-236-237-238-239-240-241-242-243-244-245-246-247-248-249-250-251-252-253-254-255-256-257-258-259-260-261-262-263-264-265-266-267-268-269-270-271-272-273-274-275-276-277-278-279-280-281-282-283-284-285-286-287-288-289-290-291-292-293-294-295-296-297-298-299-300-301-302-303-304-305-306-307-308-309-310-311-312-313-314-315-316-317-318-319-320-321-322-323-324-325-326-327-328-329-330-331-332-333-334-335-336-337-338-339-340-341-342-343-344-345-346-347-348-349-350-351-352-353-354-355-356-357-358-359-360-361-362-363-364-365-366-367-368-369-370-371-372-373-374-375-376-377-378-379-380-381-382-383-384-385-386-387-388-389-390-391-392-393-394-395-396-397-398-399-400-401-402-403-404-405-406-407-408-409-410-411-412-413-414-415-416-417-418-419-420-421-422-423-424-425-426-427-428-429-430-431-432-433-434-435-436-437-438-439-440-441-442-443-444-445-446-447-448-449-450-451-452-453-454-455-456-457-458-459-460-461-462-463-464-465-466-467-468-469-470-471-472-473-474-475-476-477-478-479-480-481-482-483-484-485-486-487-488-489-490-491-492-493-494-495-496-497-498-499-500-501-502-503-504-505-506-507-508-509-510-511-512-513-514-515-516-517-518-519-520-521-522-523-524-525-526-527-528-529-530-531-532-533-534-535-536-537-538-539-540-541-542-543-544-545-546-547-548-549-550-551-552-553-554-555-556-557-558-559-560-561-562-563-564-565-566-567-568-569-570-571-572-573-574-575-576-577-578-579-580-581-582-583-584-585-586-587-588-589-590-591-592-593-594-595-596-597-598-599-600-601-602-603-604-605-606-607-608-609-610-611-612-613-614-615-616-617-618-619-620-621-622-623-624-625-626-627-628-629-630-631-632-633-634-635-636-637-638-639-640-641-642-643-644-645-646-647-648-649-650-651-652-653-654-655-656-657-658-659-660-661-662-663-664-665-666-667-668-669-670-671-672-673-674-675-676-677-678-679-680-681-682-683-684-685-686-687-688-689-690-691-692-693-694-695-696-697-698-699-700-701-702-703-704-705-706-707-708-709-710-711-712-713-714-715-716-717-718-719-720-721-722-723-724-725-726-727-728-729-730-731-732-733-734-735-736-737-738-739-740-741-742-743-744-745-746-747-748-749-750-751-752-753-754-755-756-757-758-759-760-761-762-763-764-765-766-767-768-769-770-771-772-773-774-775-776-777-778-779-780-781-782-783-784-785-786-787-788-789-790-791-792-793-794-795-796-797-798-799-800-801-802-803-804-805-806-807-808-809-810-811-812-813-814-815-816-817-818-819-820-821-822-823-824-825-826-827-828-829-830-831-832-833-834-835-836-837-838-839-840-841-842-843-844-845-846-847-848-849-850-851-852-853-854-855-856-857-858-859-860-861-862-863-864-865-866-867-868-869-870-871-872-873-874-875-876-877-878-879-880-881-882-883-884-885-886-887-888-889-890-891-892-893-894-895-896-897-898-899-900-901-902-903-904-905-906-907-908-909-910-911-912-913-914-915-916-917-918-919-920-921-922-923-924-925-926-927-928-929-930-931-932-933-934-935-936-937-938-939-940-941-942-943-944-945-946-947-948-949-950-951-952-953-954-955-956-957-958-959-960-961-962-963-964-965-966-967-968-969-970-971-972-973-974-975-976-977-978-979-980-981-982-983-984-985-986-987-988-989-990-991-992-993-994-995-996-997-998-999-1000-1001-1002-1003-1004-1005-1006-1007-1008-1009-1010-1011-1012-1013-1014-1015-1016-1017-1018-1019-1020-1021-1022-1023-1024-1025-1026-1027-1028-1029-1030-1031-1032-1033-1034-1035-1036-1037-1038-1039-1040-1041-1042-1043-1044-1045-1046-1047-1048-1049-1050-1051-1052-1053-1054-1055-1056-1057-1058-1059-1060-1061-1062-1063-1064-1065-1066-1067-1068-1069-1070-1071-1072-1073-1074-1075-1076-1077-1078-1079-1080-1081-1082-1083-1084-1085-1086-1087-1088-1089-1090-1091-1092-1093-1094-1095-1096-1097-1098-1099-1100-1101-1102-1103-1104-1105-1106-1107-1108-1109-1110-1111-1112-1113-1114-1115-1116-1117-1118-1119-1120-1121-1122-1123-1124-1125-1126-1127-1128-1129-1130-1131-1132-1133-1134-1135-1136-1137-1138-1139-1140-1141-1142-1143-1144-1145-1146-1147-1148-1149-1150-1151-1152-1153-1154-1155-1156-1157-1158-1159-1160-1161-1162-1163-1164-1165-1166-1167-1168-1169-1170-1171-1172-1173-1174-1175-1176-1177-1178-1179-1180-1181-1182-1183-1184-1185-1186-1187-1188-1189-1190-1191-1192-1193-1194-1195-1196-1197-1198-1199-1200-1201-1202-1203-1204-1205-1206-1207-1208-1209-1210-1211-1212-1213-1214-1215-1216-1217-1218-1219-1220-1221-1222-1223-1224-1225-1226-1227-1228-1229-1230-1231-1232-1233-1234-1235-1236-1237-1238-1239-1240-1241-1242-1243-1244-1245-1246-1247-1248-1249-1250-1251-1252-1253-1254-1255-1256-1257-1258-1259-1260-1261-1262-1263-1264-1265-1266-1267-1268-1269-1270-1271-1272-1273-1274-1275-1276-1277-1278-1279-1280-1281-1282-1283-1284-1285-1286-1287-1288-1289-1290-1291-1292-1293-1294-1295-1296-1297-1298-1299-1300-1301-1302-1303-1304-1305-1306-1307-1308-1309-1310-1311-1312-1313-1314-1315-1316-1317-1318-1319-1320-1321-1322-1323-1324-1325-1326-1327-1328-1329-1330-1331-1332-1333-1334-1335-1336-1337-1338-1339-1340-1341-1342-1343-1344-1345-1346-1347-1348-1349-1350-1351-1352-1353-1354-1355-1356-1357-1358-1359-1360-1361-1362-1363-1364-1365-1366-1367-1368-1369-1370-1371-1372-1373-1374-1375-1376-1377-1378-1379-1380-1381-1382-1383-1384-1385-1386-1387-1388-1389-1390-1391-1392-1393-1394-1395-1396-1397-1398-1399-1400-1401-1402-1403-1404-1405-1406-1407-1408-1409-1410-1411-1412-1413-1414-1415-1416-1417-1418-1419-1420-1421-1422-1423-1424-1425-1426-1427-1428-1429-1430-1431-1432-1433-1434-1435-1436-1437-1438-1439-1440-1441-1442-1443-1444-1445-1446-1447-1448-1449-1450-1451-1452-1453-1454-1455-1456-1457-1458-1459-1460-1461-1462-1463-1464-1465-1466-1467-1468-1469-1470-1471-1472-1473-1474-1475-1476-1477-1478-1479-1480-1481-1482-1483-1484-1485-1486-1487-1488-1489-1490-1491-1492-1493-1494-1495-1496-1497-1498-1499-1500-1501-1502-1503-1504-1505-1506-1507-1508-1509-1510-1511-1512-1513-1514-1515-1516-1517-1518-1519-1520-1521-1522-1523-1524-1525-1526-1527-1528-1529-1530-1531-1532-1533-1534-1535-1536-1537-1538-1539-1540-1541-1542-1543-1544-1545-1546-1547-1548-1549-1550-1551-1552-1553-1554-1555-1556-1557-1558-1559-1560-1561-1562-1563-1564-1565-1566-1567-1568-1569-1570-1571-1572-1573-1574-1575-1576-1577-1578-1579-1580-1581-1582-1583-1584-1585-1586-1587-1588-1589-1590-1591-1592-1593-1594-1595-1596-1597-1598-1599-1600-1601-1602-1603-1604-1605-1606-1607-1608-1609-1610-1611-1612-1613-1614-1615-1616-1617-1618-1619-1620-1621-1622-1623-1624-1625-1626-1627-1628-1629-1630-1631-1632-1633-1634-1635-1636-1637-1638-1639-1640-1641-1642-1643-1644-1645-1646-1647-1648-1649-1650-1651-1652-1653-1654-1655-1656-1657-1658-1659-1660-1661-1662-1663-1664-1665-1666-1667-1668-1669-1670-1671-1672-1673-1674-1675-1676-1677-1678-1679-1680-1681-1682-1683-1684-1685-1686-1687-1688-1689-1690-1691-1692-1693-1694-1695-1696-1697-1698-1699-1700-1701-1702-1703-1704-1705-1706-1707-1708-1709-1710-1711-1712-1713-1714-1715-1716-1717-1718-1719-1720-1721-1722-1723-1724-1725-1726-1727-1728-1729-1730-1731-1732-1733-1734-1735-1736-1737-1738-1739-1740-1741-1742-1743-1744-1745-1746-1747-1748-1749-1750-1751-1752-1753-1754-1755-1756-1757-1758-1759-1760-1761-1762-1763-1764-1765-1766-1767-1768-1769-1770-1771-1772-1773-1774-1775-1776-1777-1778-1779-1780-1781-1782-1783-1784-1785-1786-1787-1788-1789-1790-1791-1792-1793-1794-1795-1796-1797-1798-1799-1800-1801-1802-1803-1804-1805-1806-1807-1808-1809-1810-1811-1812-1813-1814-1815-1816-1817-1818-1819-1820-1821-1822-1823-1824-1825-1826-1827-1828-1829-1830-1831-1832-1833-1834-1835-1836-1837-1838-1839-1840-1841-1842-1843-1844-1845-1846-1847-1848-1849-1850-1851-1852-1853-1854-1855-1856-1857-1858-1859-1860-1861-1862-1863-1864-1865-1866-1867-1868-1869-1870-1871-1872-1873-1874-1875-1876-1877-1878-1879-1880-1881-1882-1883-1884-1885-1886-1887-1888-1889-1890-1891-1892-1893-1894-1895-1896-1897-1898-1899-1900-1901-1902-1903-1904-1905-1906-1907-1908-1909-1910-1911-1912-1913-1914-1915-1916-1917-1918-1919-1920-1921-1922-1923-1924-1925-1926-1927-1928-1929-1930-1931-1932-1933-1934-1935-1936-1937-1938-1939-1940-1941-1942-1943-1944-1945-1946-1947-1948-1949-1950-1951-1952-1953-1954-1955-1956-1957-1958-1959-1960-1961-1962-1963-1964-1965-1966-1967-1968-1969-1970-1971-1972-1973-1974-1975-1976-1977-1978-1979-1980-1981-1982-1983-1984-1985-1986-1987-1988-1989-1990-1991-1992-1993-1994-1995-1996-1997-1998-1999-2000-2001-2002-2003-2004-2005-2006-2007-2008-2009-2010-2011-2012-2013-2014-2015-2016-2017-2018-2019-2020-2021-2022-2023-2024-2025-2026-2027-2028-2029-2030-2031-2032-2033-2034-2035-2036-2037-2038-2039-2040-2041-2042-2043-2044-2045-2046-2047-2048-2049-2050-2051-2052-2053-2054-2055-2056-2057-2058-2059-2060-2061-2062-2063-2064-2065-2066-2067-2068-2069-2070-2071-2072-2073-2074-2075-2076-2077-2078-2079-2080-2081-2082-2083-2084-2085-2086-2087-2088-2089-2090-2091-2092-2093-2094-2095-2096-2097-2098-2099-2100-2101-2102-2103-2104-2105-2106-2107-2108-2109-2110-2111-2112-2113-2114-2115-2116-2117-2118-2119-2120-2121-2122-2123-2124-2125-2126-2127-2128-2129-2130-2131-2132-2133-2134-2135-2136-2137-2138-2139-2140-2141-2142-2143-2144-2145-2146-2147-2148-2149-2150-2151-2152-2153-2154-2155-2156-2157-2158-2159-2160-2161-2162-2163-2164-2165-2166-2167-2168-2169-2170-2171-2172-2173-2174-2175-2176-2177-2178-2179-2180-2181-2182-2183-2184-2185-2186-2187-2188-2189-2190-2191-2192-2193-2194-2195-2196-2197-2198-2199-2200-2201-2202-2203-2204-2205-2206-2207-2208-2209-2210-2211-2212-2213-2214-2215-2216-2217-2218-2219-2220-2221-2222-2223-2224-2225-2226-2227-2228-2229-2230-2231-2232-2233-2234-2235-2236-2237-2238-2239-2240-2241-2242-2243-2244-2245-2246-2247-2248-2249-2250-2251-2252-2253-2254-2255-2256-2257-2258-2259-2260-2261-2262-2263-2264-2265-2266-2267-2268-2269-2270-2271-2272-2273-2274-2275-2276-2277-2278-2279-2280-2281-2282-2283-2284-2285-2286-2287-2288-2289-2290-2291-2292-2293-2294-2295-2296-2297-2298-2299-2300-2301-2302-2303-2304-2305-2306-2307-2308-2309-2310-2311-2312-2313-2314-2315-2316-2317-2318-2319-2320-2321-2322-2323-2324-2325-2326-2327-2328-2329-2330-2331-2332-2333-2334-2335-2336-2337-2338-2339-2340-2341-2342-2343-2344-2345-2346-2347-2348-2349-2350-2351-2352-2353-2354-2355-2356-2357-2358-2359-2360-2361-2362-2363-2364-2365-2366-2367-2368-2369-2370-2371-2372-2373-2374-2375-2376-2377-2378-2379-2380-2381-2382-2383-2384-2385-2386-2387-2388-2389-2390-2391-2392-2393-2394-2395-2396-2397-2398-2399-2400-2401-2402-2403-2404-2405-2406-2407-2408-2409-2410-2411-2412-2413-2414-2415-2416-2417-2418-2419-2420-2421-2422-2423-2424-2425-2426-2427-2428-2429-2430-2431-2432-2433-2434-2435-2436-2437-2438-2439-2440-2441-2442-2443-2444-2445-2446-2447-2448-2449-2450-2451-2452-2453-2454-2455-2456-2457-2458-2459-2460-2461-2462-2463-2464-2465-2466-2467-2468-2469-2470-2471-2472-2473-2474-2475-2476-2477-2478-2479-2480-2481-2482-2483-2484-2485-2486-2487-2488-2489-2490-2491-2492-2493-2494-2495-2496-2497-2498-2499-2500-2501-2502-2503-2504-2505-2506-2507-2508-2509-2510-2511-2512-2513-2514-2515-2516-2517-2518-2519-2520-2521-2522-2523-2524-2525-2526-2527-2528-2529-2530-2531-2532-2533-2534-2535-2536-2537-2538-2539-2540-2541-2542-2543-2544-2545-2546-2547-2548-2549-2550-2551-2552-2553-2554-2555-2556-2557-2558-2559-2560-2561-2562-2563-2564-2565-2566-2567-2568-2569-2570-2571-2572-2573-2574-2575-2576-2577-2578-2579-2580-2581-2582-2583-2584-2585-2

Paralimna ciliata Cresson, 1916, Trans. Amer. Ent. Soc., XLII, p. 111. Kingston, April; Port Antonio, March 30, (C. W. Metz); Liguanea Plain, Nov. and Dec., (Brues); Balaclava; Mandeville and Clarkstown, (Thaxter).

Atissa sp. Mandeville, Battersea and Clarkstown, (Thaxter).

Psilopa aciculata Loew. Hope Garden, Feb. 22.

Psilopa willistoni Cresson. *Psilopa nigrimanus* Williston, 1896, Trans. Ent. Soc., London, p. 393. *non* v. Ros., 1840. Montego Bay, Feb. 25, (Cushman); March 15, (Grossbeck).

Ilythea sp. Balaclava, Williamsfield, and Clarkstown; Mandeville; Battersea, (Thaxter).

Ochthera exculpta Loew. Kingston and Port Antonio, April.

Ochtheroidæ glaphyropus (Loew). *Athyroglossa glaphyropus* Loew, 1878, Zetisch. f. Ges. Naturwiss., p. 198. Mandeville and Porus, (Thaxter).

Discocerina leucoprocta Loew. Port Antonio, March 30, (Metz).

Discocerina parva Loew. Port Antonio, March 30, (Metz); Montego Bay, Feb. 28, (Grossbeck).

Napaea humilis (Williston). *Parydra humilis* Williston, 1897, Kans. Univ. Quart., VI, p. 7. Balaclava, (Thaxter).

CHLOROPIDÆ

Hippelates bicolor Coquillett. Montego Bay, March 15, (Grossbeck).

Hippelates dorsalis (Loew). Catadupa, March 9, (Grossbeck).

Hippelates convexus Loew. Yallahs Valley, Blue Mts., Feb. 27; Cinchona, March 9, (Grossbeck); Montego Bay, Feb. 25, (Cushman).

Hippelates flavipes Loew. Montego Bay, March 2; Cinchona, Feb. 25, (Grossbeck).

Crassiseta attenuata Adams. Hope Gardens, Feb. 22. The specimen before me is in poor condition, with the aristæ wanting. As it agrees, however, with a specimen from Florida in my collection, I have little doubt of the identification.

Siphonella sp. Jamaica, (Thaxter).

DROSOPHILIDÆ

Drosophila melanogaster Meigen. *D. ampelophila* Loew, of authors. Kingston, April 15.

Drosophila opaca Williston. Port Antonio; Porus, (Metz).

Drosophila repleta Wollaston. *D. punctulata* Loew, 1862, Cent., II, p. 100. Kingston, April 15.

Drosophila willistoni Sturtevant. *D. pallida* Williston, 1896, Trans. Ent. Soc. London, p. 415 (*non* Zetterstedt, 1847). Porus, (Metz).

Drosophila similis Williston. Port Antonio; Porus, (Metz).

Drosophila cardini Sturtevant, 1916, Ann. Ent. Soc. Amer., IX, p. 336. Porus, (Metz).

Drosophila lutzii Sturtevant, 1916, Ann. Ent. Soc. Amer., IX, p. 340. Hope Gardens, (Metz).

Scaptomyza graminum (Fallen). Yallahs Valley, Feb. 27.

Sigaloessa sp. Mandeville, (Thaxter).

AGROMYZIDÆ

Agromyza cærulea Malloch, 1913, Ann. Ent. Soc., Amer., VI, p. 322. Kingston, April.

Agromyza maculosa Malloch. Port Antonio, May; Yallahs Valley, Feb. 27.

Agromyza minima Malloch. Kingston and Port Antonio, April-May.

Agromyza platyptera var. **allecta** Melander, 1913, Journ. N. Y. Ent. Soc., XXI, p. 257. Cinchona, Feb. 25; Yallahs Valley, Feb. 27; Montego Bay, Feb. 28.

Agromyza plumiseta Malloch. Kingston, April; Hope Gardens, Feb. 22; Yallahs Valley, Feb. 27; Catadupa, March 9; Montego Bay, Feb. 25, (Cushman).

Agromyza viridula Coquillett. Hope Gardens, Feb. 22; Montego Bay, Feb. 22.

Agromyza melampyga Loew. Montego Bay, Feb. 25, March 6, (Cushman).

Cerodontha dorsalis (Loew). Liguanea Plain, Nov.-Dec., (Brues).

Desmometopia m-nigrum (Zetterstedt). Port Antonio, April; Montego Bay, Feb. 25-March 4, (Cushman).

Pholeomyia indecora (Loew). Kingston, April.

Milichiella lacteipennis (Loew). Kingston, April.

Milichiella argenteocincta, new species

FEMALE.—Front black, opaque, vertical orbits shiny, face silvery white, with six orbital bristles; antennæ dark brown, base yellow. Thorax black, slight grayish pruinose, one post-acrostical scutellum with four large marginal bristles. Abdomen black, the terminal segment shiny greenish black, the others opaque with a prominent silvery band on the posterior margin of the second segment, third segment with a narrow posterior margin. Legs black. Halteres bright yellow. Wings grayish hyaline. Length, 3 mm.

One specimen, Kingston, April 1891.

Ochthiphila quadrata, new species

Front grayish with a blackish transverse stripe above the antennæ, from which extend two lines to the vertex; face silvery white, orbits blackish; palpi and antennæ yellowish (the terminal joint of the latter wanting). Thorax grayish pruinose, with four obscure longitudinal lines, the middle pair abbreviated posteriorly, an obscure yellowish lateral line extends from the humerus to the base of the wing. Abdomen light gray, a pair of large, velvety black, quadrate spots on all but the first segment, which is black except for the narrow posterior margin. Halteres yellow. Femora and base of the tibiæ black; knees, the greater portion of the tibiæ and all of the tarsi yellow. Wings grayish hyaline. Length, 2.5 mm.

One specimen, Cinchona, Feb. 25, 1911 (Grossbeck). Type in The American Museum of Natural History.

Differs from *O. elegans* Panz. in having much larger quadrate markings on the abdomen.

Spilochroa ornata (Johnson). Montego Bay, March 4, (Cushman).

Rhinoëssa willistoni Melander. *Anthomyza cinerea* Williston, 1896, Trans. Ent. Soc. London, p. 444, Pl. xiv, fig. 170. *Non R. cinerea* Loew, 1862. *R. willistoni* Melander, 1913, Journ. N. Y. Ent. Soc., XXI, p. 298. Kingston, April.

**Article IX.—REPORT ON THE BREMIDÆ COLLECTED BY THE
CROCKER LAND EXPEDITION, 1913–1917¹**

BY THEODORE H. FRISON

PLATE XXIV

Among the various insects collected by the Crocker Land Expedition are forty-four specimens of Bremidæ (= Bombidæ).² There are three species in all, representing two of our North American groups of bumblebees as adopted by Dr. H. J. Franklin in his monograph of 1913. The *Pratorum* Group of Radoskowski (1884) is represented by a single specimen of *Bremus couperi* (Cresson), and the *Kirbyellus* Group of Franklin by a series of *B. hyperboreus* (Schönherr) and *B. polaris* (Curtis).

Nearly one-half of the specimens were moldy but not so badly that identification was impossible. Mites were abundant on the specimens, occurring on all parts of the body.

Mr. W. E. Ekblaw, a member of the expedition, has very kindly furnished the writer with data concerning the environmental conditions under which the bumblebees live in western Greenland.

PRATORUM GROUP, RADOSKOWSKI

Bremus couperi (Cresson)

One specimen of the worker of *B. couperi* (Cresson) was collected by the members of this expedition. As this is the first time that the worker of this species has ever been taken, a description of it is included in this article. The specimen was collected at the Bay of Islands, Newfoundland, on July 21, 1913. The queen of this species was first described by Cresson (1878) and redescribed by Franklin from nine specimens in 1913. Franklin records the species from "Labrador, Isle Royal in Lake Superior, Mountains east of Codroy and Bay of Islands in New Foundland, Nepigon in Ontario and Anticosti Island."

In addition to the above, I have what is undoubtedly the male of this species collected by Mr. F. W. L. Sladen at Painsec, New Brunswick, on August 4, 1914. Mr. Sladen says that the male was taken at the same time and in the same place as the queens of *B. couperi* (Cresson). *B. frigidus* (F. Smith) is considered to be very closely related to *B. couperi* (Cresson) and Franklin says: "It seems quite possible that extensive

¹Scientific Results of the Crocker Land Expedition.

²The change from *Bombus* to *Bremus* depends on the acceptance of the "Erlangen List," a still debatable point.—EDITOR.

collecting prove that it should be considered either a subspecies or color variant of that species." A comparison of the genitalia, however, shows that, although closely related to *B. frigidus* (F. Smith), *B. couperi* (Cresson) is a distinct species.

In general, the male of *B. couperi* (Cresson) differs in external appearance from the male of *B. frigidus* (F. Smith) in that only the tenth dorsal abdominal segment and the posterior border of the sixth segment (a few hairs) bear ferruginous pubescence. The corbicular are dark in *B. couperi* (Cresson) and not tawny or ferruginous as in *B. frigidus* (F. Smith). It likewise differs from the male of *B. frigidus* (F. Smith) (Fernald, 1916) in that there is no yellow pubescence on either the fifth or sixth abdominal segments, while the tenth segment is ferruginous.

B. couperi (Cresson) is a boreal species, but not nearly so much so as the other two species considered in this paper. A large number of the members of the *Pratorum* Group occur in the Austral and Transitional Zones.

The description of the male has been included along with that of the worker.

WORKER

In general like the queen.

Face with numerous black hairs above and below the bases of the antennae; occiput mostly black, with a few yellow hairs near the center; cheeks black. Labrum with tubercle areas clearly separated, strongly rounded at basal margin, and sparsely punctate at mesal edge; shelf-like projection not prominent. Malar space about the same width as its apex, about one-fifth as long as the eye and impunctate. Clypeus moderately punctate, except for a rather impunctate central area. Antennae with flagellum about twice as long as the scape; third antennal segment longer than the fifth, the fourth and fifth segments being nearly subequal in length. Ocelli not situated below the supra-orbital line and arranged nearly on the same straight line. Area below and on the sides of the ocelli more or less impunctate.

Thorax with a broad black band between the bases of the wings; the anterior portion of the dorsum and the scutellum with yellow pubescence; pleura with yellow pubescence extending to the bases of the legs.

Abdomen with the first two dorsal abdominal segments covered with yellow pubescence; third and fourth segments black, except for some yellowish hairs on the extreme lateral margins; fifth segment with yellowish hairs throughout; sixth segment black. Venter with many light hairs on the third, fourth and fifth segments. No medium carina on hypopygium. Pubescence throughout somewhat fine and long.

Legs mostly black, except for some yellowish hairs near their proximal ends; corbicular fringes in this specimen black.

Length, 12 mm.; spread of wings, 24 mm.; width of abdomen at second segment, 6 mm.

MALE

Face and occiput well covered with yellow pubescence, the hairs above the bases of the antennæ noticeably darker than those below. Cheeks with a large number of light-colored hairs. Labrum with tubercle areas not prominent and not sharply separated, punctate. Malar space slightly longer than its width at apex. Clypeus densely covered with whitish yellow pile. Fifth antennal segment longer than either the third or fourth segments, the third segment being longer than the fourth.

Dorsum of the thorax with a distinct black band between the bases of the wings. Anterior portion of the thorax, the scutellum, and the pleura to the bases of the legs covered with yellow pubescence.

Abdomen with the first two dorsal segments yellow; third, fourth, fifth, and sixth segments black; seventh segment dull ferruginous. Ventral segments with a few pale hairs.

Legs with many light hairs at their bases on the inner surfaces. Femora of the fore and middle pairs of legs almost entirely covered with long pale hairs; hind femora considerably darker. Corbicular fringes black.

Length, 15 mm.; spread of wings, 28 mm.; width of abdomen at second segment, 7 mm.

The genitalia (Fig. 1) agree in their essential characters with the description of the genitalia of the *Pratorum* Group as described by Dr. Franklin. They may be distinguished from those of *B. frigidus* (F. Smith) by the more dilated or pad-like sickle-shaped head of the sagittæ. In *B. frigidus* (F. Smith) the cephalic aspect of the sickle-shaped head of the sagittæ decreases gradually in width from the base of the hook to the apex, except for an occasional very slight dilatation, or is constant in thickness. In *B. couperi* (Cresson) the cephalic aspect shows the apex of the hook of the sagittæ to be more curled and dilated. In respect to the dilatation of the apex of the sickle-shaped hook of the sagittæ, *B. couperi* (Cresson) resembles *B. vagans* (F. Smith) more than the remainder of the *Pratorum* Group which I have seen. The inner margins of the sagittæ at their bases are also more bulging in *B. frigidus* (F. Smith) than in *B. couperi* (Cresson).



Fig. 1. Photograph of the Dorsal Aspect of the Genitalia of *Bremus couperi* (Cresson).

KIRBYELLUS GROUP, FRANKLIN

All the bumblebees collected in Greenland by the members of this expedition belonged to this interesting group. Two species, *B. hyperboreus* (Schönherr) and *B. polaris* (Curtis), were taken and are repre-

sented by a series of forty-three specimens. It is surprising that *B. kirbyellus* (Curtis) is not in the collection, as it is reported from Greenland.

DISTRIBUTION AND GENERAL HABITS

The *Kirbyellus* Group is the most boreal group known and occurs in the colder parts of both the Old and New Worlds. Both *B. hyperboreus* (Schönherr) and *B. polaris* (Curtis) have the long, fine pile which is so characteristic of the northern species of bumblebees. The development of hairy species of insects is also very noticeable in the case of Diptera. *B. polaris* (Curtis) well illustrates the development of ferruginous pubescence so frequently found in bumblebees of a northern distribution. *B. hyperboreus* (Schönherr), however, judging by the plain, sober black and yellow of its pubescence, might easily be mistaken for a more austral form.

The life history and conditions (see Plate XXIV) under which these northern species of bumblebees live are very interesting. Nielson (1907) says "The Hymenoptera follow after the Diptera with the greatest number of species (52). With the exception of the humble-bees, that are common to both East and West, and the three saw-flies, of which two are found in the West and one in the East, all the remainder belong to the Ichneumon-forms." The fact that the bumblebees are so commonly met with in the arctic regions where so few hymenopterous genera, in fact any insect genera, are known to occur is rather indicative of an northern ancestry. Dr. F. E. Lutz (1916) holds the opinion that the bumblebees actually originated in the north at a time when the climatic conditions were at least mild.

All the specimens of this group were collected between latitudes 76° 30' N. and 78° 20' N. The bumblebees occur much farther north than this, however, and were observed in Discovery Harbor in latitude 81° 40' N. The most northern record for a bumblebee of which I am aware is that given by M'Lachland (1877) where he states: "Moreover there are two species of Humble-bees, and an example of one of these was chased by Capt. Feilden (but not captured) in so far north as latitude 82° 30'."

When the bumblebees are first on the wing the temperature is about 35–40° F. near the latitude where the majority of the bumblebees in this collection were taken (76° 30' N.). The highest temperature (55–60° F.) is reached about August. It was observed that when the temperature fell rapidly the bumblebees crawled about on the surfaces

and in the crevices of warm rocks. A queen of *B. hyperboreus* (Schönherr) has likewise been observed sitting on a rock by V. G. Jakobson (1898).

The bumblebees of the arctics are very industrious and may be found working on the flowers for pollen and nectar the whole twenty-four hours of a day.

TIME OF APPEARANCE OF THE BUMBLEBEES AND THEIR ANTHOPHILOUS HABITS

In Greenland, as throughout their entire range, the bumblebees are dependent for their existence upon the flowers; and the arctic flowers require the services of the insects for their cross-fertilization. In a region like Greenland, where the insect agents of pollination are so scarce, the importance of the bumblebees to the flowers is evident. The first flowers begin to bloom in the month of May. In 1916, the first flowers of *Saxifraga oppositifolia* appeared on May 17 and those of *Salix arctica* on May 7. At this time the sun is gradually reaching its maximum height and shines steadily twenty-four hours a day. Patches of gravel from which the snow has melted then begin to be covered with various kinds of flowers.

The first bumblebee noticed by Mr. Ekblaw in 1916 was on May 26. Nielson (1911) says "the hibernating queens appear in the middle of June and the workers appear already (*sic?*) at the end of this month." It is probable that the queens appear a week or so earlier than Nielson observed. Judging from the habits of the species of bumblebees whose life histories are better known, the immature stages require about a month's time before reaching maturity (Frison, 1917, 1918). By the middle of August the summer begins to wane, the flowers to disappear, and the bumblebee queens to seek their winter quarters.

The bumblebees are commonly found in Greenland on the flowers of *Saxifraga*, *Pedicularis*, *Potentilla*, *Salix*, *Dryas*, *Rhododendron*, *Cassiope*, and *Hesperis*. Altevand report *B. hyperboreus* Schönherr in Norway on *Astragalus alpinus*.

• NESTING HABITS

The bumblebees in the arctic regions are on the wing scarcely three months. One might easily infer from the relatively short active season, that the bumblebee colonies never get to be as large or prosperous as those established in temperate climates. Two nests were found by

the expedition. The larger of these two contained about thirty individuals and the smaller about twenty. The nests were in crevices in the rocks, the crevices being filled with grass and moss. Another observer, Nielson, found a queen of *B. hyperboreus* (Schönherr) "at the end of June in the act of crawling down into a marmot hole, presumably seeking for a place to build its nest. On digging out the marmot hole a clump of old, moulded bumblebee cocoons was found in it." It would be interesting to know if these cocoons were the remains of a nest of the previous year or a deserted nest of the same year. It seems strange that a queen should be seeking a nest at the end of June in a region where the season is so short and already so well advanced. According to the same writer both *B. hyperboreus* (Schönherr) and *B. balteatus* (Dahlbom) build their nests under the ground in deserted marmot and lemming holes. A further account is given by Nielson (1911) of the finding of a nest of *B. balteatus* (Dahlbom) on July 15, 1908, on the northeastern coast of Greenland. This nest was "padded with a thin layer of moss and indeterminable bits of plants." The nest contained twenty empty worker cocoons, thirteen larvæ, eleven pupæ, and about twenty eggs. No mention was made of the exact number of individuals in the nest when it was opened.

It is a question as to what species of bumblebee is referred to by *B. balteatus* (Dahlbom). Dr. Franklin lists *B. balteatus* (Dahlbom) as a questionable synonym of *B. kirbyellus* (Curtis), and Friese and Wagner (1912) have done likewise. There is a possibility, however, that the *B. balteatus* (Dahlbom) mentioned by Nielson may be *B. polaris* (Curtis).

B. hyperboreus (Schönherr) is recorded by V. G. Jakobson (1898) as nesting deep in the ground between thin plates of slate. An Eskimo stated to Mr. Ekblaw that the bumblebees occasionally nest in the deserted nests of the snow-bunting (*Plectrophenax nivalis nivalis* Linneus). The Eskimos are said to be very much afraid of being stung by the bumblebees.

***Bremus hyperboreus* Schönherr**

B. hyperboreus (Schönherr) (1809) is the name adopted for the species listed by Franklin as *Bombus arcticus* (Kirby) (1821), for the two are undoubtedly the same, *B. hyperboreus* (Schönherr) having priority. Dr. Franklin states: "It is not improbable that this is the same species which is present in the northern regions of Europe and Asia and is known as *B. hyperboreus* Schönherr." My reasons for considering the

two identical are the following. First, one of the species of *Bremus* known from the west coast of Greenland by the European workers is styled by them as *hyperboreus* Schönherr. Second, the color patterns of both are the same. Third, a comparison of the genitalia with the figure of Friese and Wagner and the description by Dr. Schmiedeknecht (1882) proves them to be identical.

By way of comment on the above, it is rather strange to suppose that, where so few species are to be found, the European workers should always find *B. hyperboreus* (Schönherr) and never *B. arcticus* (Kirby) and the Americans vice versa. I know of no instance in which two species of bumblebees have exactly the same coloration without some external distinguishing marks. Furthermore, though the figure by Friese and Wagner is poor, the genitalia of the male in hand agrees with the figure cited. This is all the more strikingly brought out by a comparison with the figure of the genitalia of *B. kirbyellus* (Curtis) by the same authors; in the latter the inner margin of the squama is shown to be less straight and the inner apical projection of the volsella not extending so far forward into a point as in *B. hyperboreus* (Schönherr).



Fig. 2. Photograph of the Dorsal Aspect of the Genitalia of *Bremus hyperboreus* (Schönherr).

Figure 2 is from a photograph of the dorsal aspect of the genitalia of this species.

***Bremus polaris* Curtis**

B. polaris (Curtis) is represented in the collection by twelve queens and thirty-seven workers. Some of the specimens of this species are from one of the nests opened by the members of this expedition. The variation in the color of the pubescence is noticeable in the series; the pubescence of the apical dorsal abdominal segments varying from a deep ferruginous to a dull yellow color. In two workers the third

segment is almost entirely covered with yellowish instead of blackish pubescence. One worker is malformed in that the posterior medial margin of the third dorsal segment is deeply incurved, the remaining apical segments being much flattened and the pubescence very short. The clypeus of this specimen is also rugose.

There is considerable variation in the size of the workers. Several of the workers were scarcely 10 mm. in length, with a wing expansion of 24 mm. and the second abdominal segment less than 6 mm. wide.

Friese and Wagner considered only two species of bumblebees as occurring in the arctic regions, but we now know that there are three. It seems highly probable that some of the references (*B. balteatus* Dahlbom and *B. nivalis* Dahlbom) listed under *B. kirbyellus* (Curtis) apply to *B. polaris* (Curtis). Nielson says that *B. balteatus* (Dahlbom) has the same distribution as *B. hyperboreus* (Schönherr), which occurs along the whole west coast of Greenland. The fact that *B. hyperboreus* (Schönherr) and *B. polaris* (Curtis) are associated so closely in this collection seems to indicate that what Nielson called *balteatus* Dahlbom may be what we know as *polaris* Curtis. *B. kirbyellus* (Curtis) is more western in its range than either *B. hyperboreus* (Schönherr) or *B. polaris* (Curtis) and is found in Alaska.

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Fig. 1. Photograph of a *Rhododendron* Heath on the Northwestern Coast of Greenland. The arctic willow also grows here and it is in such places as this that one most frequently finds the arctic bumblebees.



Fig. 2. Photograph of a Typical Ranging and Feeding Ground of *Bremus hyperboreus* (Schönherr). On the northwestern coast of Greenland.

**Article X.—DIAGNOSES OF TWENTY-THREE NEW SPECIES
AND A NEW GENUS OF LIZARDS FROM
LOWER CALIFORNIA**

BY M. C. DICKERSON

This preliminary statement of diagnoses of new species precedes a larger preliminary paper on the lizard fauna of Lower California and the Southwest, which will include descriptions and discussions, illustrations, reviews of various genera, with maps and keys.

The twenty-three species presented here are based on material collected by the Albatross Expedition to Lower California in 1911, under the auspices of the United States Bureau of Fisheries and The American Museum of Natural History. The types are to be deposited in the United States National Museum.

Among the forms represented, some are species of great distinctness, more or less remote from all other known forms, such as the two species of *Sauromalus* from San Esteban and La Paz; others, like the two *Ctenosaurus* from San Esteban and Cerralvo, are species by island isolation, restricted to their type localities, and showing relatively close relationship with well-known mainland forms. The two species introducing the new genus *Sator* are primitive forms of considerable interest in the phylogenetic history of the Iguanidæ.

1. *Ctenosaura conspicuosa*,¹ new species

TYPE.—A. M. N. H. No. 5027, ♂. Collector, C. H. Townsend, Albatross Expedition, April 13, 1911.

PARATYPES.—A. M. N. H. Nos. 5640 ♀, 2278, 2693, 2695, 5639.

TYPE LOCALITY.—San Esteban Island, Gulf of California, Mexico.

DIAGNOSIS.—Closely related as shown by scutellation to *Ctenosaura hemilopha* Cope, of the Cape Region. Size extremely large, total length exceeding 650 mm. in the large males, for which the following characters are diagnostic: series of high scales of the crest ending more or less abruptly at a point opposite the middle of the adpressed upper arm, the small keeled scales which continue along the vertebral line traceable to various points beyond the middle of the body and anterior to the rump; scales of dorsal tibia with strong sharp keels and spines, of dorsal foot with strong spines; tail spinous dorsally and laterally throughout its length; enlarged scales in the posterior rows of the caudal whorls (first half of tail) only moderate in size, length

¹Because of its yellowish white color, this giant lizard is very conspicuous on the rocks of San Esteban, as is also the big yellow *Sauromalus* (*S. varius*, new species).

of largest equal to 9 dorsal scales, often exceeded by tallest spines of dorsal crest; width of the widest whorl (2 rows dorsally) very much less than distance from nostril to anterior orbit; base of 5th to end of 4th toe equal to distance from anterior border of ear to end of muzzle. Color light yellowish; black or intensely dark brown on gular region and fold, breast and thoracic region to the line of the wrists (when arms adpressed), also axilla and lateral area as high as the dorsolateral line; a short lenticular black spot crosses the back between the points of insertion of the arms (its middle corresponding with line of axillas), connected at its narrowed ends with somewhat irregular, longitudinal lines of black which, with the lenticular spot, mark out a rectangle containing a central black spot, while a smaller black spot anteriorly on the sides of the crest indicates the middle of the anterior boundary of the rectangle;

straight band of black crosses the back on a line with the elbows, curving at the sides to dorsolateral line.

MEASUREMENTS OF TI

tail, 382; tip of muzzle,

width, 60; hind leg, 170; nas.

The largest females 301

large males; the crest is

dy, the foot has a proportion

and shorter, so that from base of 5th to r

head from anterior ear to end of muzzle;

relatively smaller, and the coloration is a

rump and axilla more or less cons

MEASUREMENTS OF No. 5646

anus, 207; tail, 345; tip of muzzle to f

35; head width across middle of orbits, 20; axilla to nostril, 81; axilla to anterior

border of ear, 46; width of widest caudal whorl, 8.5; hind leg, 125; base of 5th to end

of 4th toe, 49.

h, 668 mm.; tip of muzzle to anus,

muzzle to posterior border of ear, 71;

of 4th toe, 64.

ly about two-thirds the size of the

t ending at about the middle of the

e males, but the head is much smaller

h toe considerably exceeds length of

arged scales of the caudal whorls are

with 7 narrow light bands between

length, 552 mm.; tip of muzzle to

ielded part of head, 43; head width,

Comparison of the measurements of *Ctenosaura townsendi*, new species, and *Ctenosaura conspicuosa* shows that the *Ctenosaura* on Cerralvo Island is a species of considerably stouter build, with greater breadth of head and shorter neck than the San Esteban form.

2. *Ctenosaura insulana*, new species

TYPE.—A. M. N. H. No. 2694, ♂. Collector, C. H. Townsend, Albatross Expedition, April 19, 1911.

PARATYPES.—A. M. N. H. Nos. 5641 ♀, 5568–5569, immature.

TYPE LOCALITY.—Cerralvo Island, Gulf of California, Mexico.

DIAGNOSIS.—With close resemblance in scutellation to *Ctenosaura hemilopha* Cope, of the Cape Region. Total length often exceeding 600 mm. in the large males, for which the following characters are diagnostic: high scales of the crest graduated to a point on a line just posterior to the elbows, small keeled crest scales traceable about two-thirds the distance to the rump; scales on dorsal tibia smooth or very weakly keeled, dorsal scales on foot without spines or very shortly mucronate; tail spinous to the end; scales in posterior rows of the caudal whorls very large on first half of tail, length of largest equal to 14 dorsal scales, not exceeded by length of tallest scales in

crest; width of the whorl (2 rows dorsally) equal to distance between nostril and anterior angle of orbit; base of 5th to end of 4th toe equal to distance from anterior ear to nostril; femoral pores, 5-6. Color light yellowish, with gular region, breast, and arms black; short transverse bar of black posterior to points of arm insertion (its anterior margin about on line of axillas), connected at ends with narrow longitudinal straight lines of black forming a square open on anterior side, containing black spot at center on crest; a second black bar crosses back posterior to this, curving downward and backward to meet black of breast.

MEASUREMENTS OF THE TYPE.—Total length, 608 mm. +; tip of muzzle to anus, 295; tail, 313 + (reproduced); tip of muzzle to fold, 113; tip of muzzle to posterior border of ear, 84; anterior border of ear to nostril, 62; head width, 74; hind leg, 166; base of 5th to end of 4th toe, 62.

The largest females in the collection measure only two-thirds the length of the large males; the crest is very low, ending about the middle of the body, the foot has a proportionate length as in the large males but the head is smaller and shorter (so that length from base of 5th to end of 4th toe greatly exceeds distance from anterior ear to nostril); the enlarged scales of the caudal whorls are smaller; the general coloration is darker and the color pattern retains the transverse light bands, or series of spots (7 between rump and axilla) of the immature.

MEASUREMENTS OF No. 5641 ♀.—Total length, 471; tip of muzzle to anus, 191; tail, 280; tip of muzzle to fold, 62; shielded part of head, 43; head width, 38; head width across middle of orbits, 25; axilla to nostril, 74; axilla to anterior border of ear, 42; width of widest caudal whorl, 10; hind leg, 120; base of 5th to end of 4th toe, 47.

3. *Sauromalus interbrachialis*,¹ new species

TYPE.—A. M. N. H. No. 6809. Collector, C. H. Townsend, Albatross Expedition, March 27, 1911.

PARATYPE.—A. M. N. H. No. 6808 (immature).

TYPE LOCALITY.—La Paz, Lower California, Mexico.

DIAGNOSIS.—Size medium, 280 mm. total length of largest specimen known (U. S. N. M. No. 12633); nuchal scales smooth, not as large as the largest head scales, scarcely larger than the supraoculars; very much smaller than the largest preauricular scale; scales on postauricular folds tubercular, not greatly enlarged; dorsal scales relatively smooth, small, from 26 to 30 in a head length; ventral scales from gular fold to anus, 133; femoral pores, 14. Color tawny brown sprinkled evenly with small dark spots everywhere dorsally and laterally between nape and tail, less conspicuously on dorsal surfaces of legs, on the breast and gular region, and below the lateral fold to the groin; a double dark bar over the back between the arms, with faint indications of a similar double bar anteriorly and three posteriorly.

MEASUREMENTS OF THE TYPE.—Total length, 250 mm.; length of head and body to anus, 129; tail length, 130; tip of muzzle to posterior border of ear, 30, to gular fold, 46; head width, 27; hind leg, 74; hind foot, 31; base of 5th to end of 4th toe, 23.

The medium-sized chuckwalla collected in 1882 by L. Belding on the island of Espiritu Santo is *Sauromalus interbrachialis* (U. S. N. M.

¹With reference to the double dorsal bar between the arms.

No. 12633; Belding, 1887, West American Scientist, III, p. 97; Stejneger, 1891, Proc. U. S. Nat. Mus., XIV, p. 409). It is a somewhat larger, older specimen than the type from La Paz.

Belding's specimen from Espiritu Santo, examined through the courtesy of Dr. Stejneger, measures 280 mm., total length; 183, length; it has 139 ventral scales from gular fold to anus, and 26 dorsal scales in a head length; femoral pores, 15.

4. *Sauromalus townsendi*,¹ new species

TYPE.—A. M. N. H. No. [redacted] Collector, C. H. Townsend, Albatross Expedition, April 12, 1911.

TYPE LOCALITY.—Tiburo [redacted] California, Mexico.

DIAGNOSIS.—General resemblance to *S. ater* Duméril but with coarser scutellation throughout, especially on the head; head length, 302 mm.; dorsal scale rows in head length, 28; ventral scales, 125; number of scales around the body, 125; coloration yellowish, with head, shoulders, brachials, gular region, and sides of the body, also lumbar region and hind legs, darker. There is an irregular freckling of the same color dorsally and ventrally, very dense on the head and sides.

MEASUREMENTS OF THE TYPE.—Head and body to anus, 302 mm.; head and body to tip of snout, 166; tail, 125+ (reproduced); tip of snout to posterior border of ear, 39, to gular fold, 55; head width, 36; hind leg, 100; hind foot, 46; base of 5th to end of 4th toe, 34.

This is possibly the species reported by L. Belding from Guaymas in 1887 (West American Scientist, III, p. 97). Its resemblance to *S. ater* Duméril may signify connection with that species in Sonora in former times if not to-day.

5. *Sauromalus varius*, new species

TYPE.—A. M. N. H. No. 5633. Collector, C. H. Townsend, Albatross Expedition, April 13, 1911.

PARATYPES.—A. M. N. H. Nos. 2698–2702, 5026, 5610–5632, 5634–5638, 5706–5708.²

TYPE LOCALITY.—San Esteban Island, Gulf of California, Mexico.

COMMON NAME.—Piebald Chuckwalla.

DIAGNOSIS.—Size very large, sometimes exceeding 600 mm.; nuchal scales somewhat enlarged medially, smaller than largest head scales and preauricular scales, with only faint tendency to formation of spines posteriorly; postauricular scales small; dorsal scales smooth, median subquadrangular, lateral with tendency to

¹Named in honor of C. H. Townsend, leader of the Albatross Expedition, 1911.

²Three additional specimens are mounted and on exhibition in the Lower California Habitat Group of lizards, and A. M. N. H. No. 2701 has been made into a study skeleton.

formation of posterior spine; dorsals small, larger in mid-dorsal region especially anteriorly, rows in head length near median line 28, 15 mm. distant from median line, 37; number of ventral scale rows from gular fold to anus, 143 (average in 15 specimens); scales around thickest part of tail, 72 (average in 15 specimens); femoral pores not variable, averaging 17. General color light yellowish to light reddish brown, with irregular blotching and mottling of dark over all dorsal and lateral surfaces, giving a piebald appearance.

MEASUREMENTS OF THE TYPE.—Total length, 547 mm.; head and body to anus, 250; tail length, 297; tip of muzzle to posterior margin of ear, 58, to gular fold, 84; head width, 58; hind leg, 155; foot, 70; base of 5th to end of 4th toe, 54.

6. *Callisaurus carmenensis*, new species

TYPE.—A. M. N. H. No. 5388, ♂. Collector, C. H. Townsend, Albatross Expedition, April 2, 1911.

PARATYPE.—A. M. N. H. No. 5389, ♀.

TYPE LOCALITY.—Carmen Island, Gulf of California, Mexico.

DIAGNOSIS.—A small *Callisaurus* rather closely related to *C. plasticus*, new species, but with finer scutellation throughout, especially noticeable in dorsals, scales forming denticulated margin of gular fold, on chest posterior to gular fold, inferior shoulder patches of enlarged scales, and tibials; femoral pores variable, averaging 14. Blue lateroventral area very small changing to purplish brown posteriorly; black lateroventral bands obscure, short and narrow, parallel, somewhat curved; tail black-spotted below only.

MEASUREMENTS OF THE TYPE.—Head and body to anus, 62 mm.; tail length, 58+ (reproduced); tip of muzzle to posterior margin of ear, 16, to gular fold, 21; head width, 13; hind leg, 62; hind foot, 30; base of 5th to end of 4th toe, 26.

7. *Callisaurus inusitatus*,¹ new species

TYPE.—A. M. N. H. No. 5324, ♂. Collector, C. H. Townsend, Albatross Expedition, April 13, 1911.

PARATYPES.—A. M. N. H. Nos. 5317–5337, 5339–5341, 5344–5346, 5397.

TYPE LOCALITY.—Tiburón Island, Gulf of California, Mexico.

SYNONYMS.—*Callisaurus draconoides ventralis* (part), Cope, 1898 (1900), Rept. U. S. Nat. Mus., p. 273; *Callisaurus ventralis ventralis* (part), Stejneger and Barbour, 1917, Check List, p. 47.

DIAGNOSIS.—Size large, adults often exceeding 200 mm. total length. Hind leg equal to or longer than distance from snout to anus, reaching beyond muzzle when stretched forward along body; femoral pores, 18 (average of 29 specimens). Black lateral bands, 2; very oblique forward, long but variable in width, irregular in outline; usually obscurely marked, united inferiorly along the margin of the blue area, producing between them a conspicuous U-shaped blue spot below the lateral fold. Blue lateroventral area prominent and extending nearly to groin. Ventral tail white with 6–9 black crossbands; dorsal caudal surface brown with markings brown not black.

¹With reference to the union inferiorly of the black lateroventral bands, unknown in any other species of *Callisaurus* or in *Holbrookia*.

MEASUREMENTS OF THE TYPE.—Length of head and body to anus, 93 mm.; tail length, 109; tip of muzzle to posterior margin of ear, 19, to denticulated gular fold, 27; head width, 15; hind leg, 80; hind foot, 37; base of 5th to end of 4th toe, 32.

I have what seems to be this species (female specimen only) also from Guaymas, Sonora, Mexico, in the W. W. Brown collection loaned for study by the Museum of Comparative Zoology. *C. inusitatus* may possibly intergrade with *C. ventralis ventralis* (Hallowell) somewhere in Sonora.

8. *Callisaurus plasticus*,¹ new species

TYPE.—A. M. N. H. No. [redacted] collector, C. H. Townsend, Albatross Expedition, April 1, 1911.

PARATYPES.—A. M. N. H. Nos. [redacted] 6, San José Island, Nos. 5346-5348, [redacted] ge, Nos. 5351-5356, Concepcion Bay (south end), Nos. 5381-5383, San José Bay, Lower California.

TYPE LOCALITY.—Acapulco, Lower California, Mexico.

SYNONYM.—*Callisaurus draconoides* Blainville (part), Cope, 1898 (1900), Rept. U. S. Nat. Mus., p. 269.

DIAGNOSIS.—Total length of adult exceeding 170 mm. Hind leg in male about equal to length from snout to anus when stretched forward along body. Number of femoral pores highly variable, 13-19, averaging 15 (39 specimens). An irregular broad band of blue below the lateral fold from just posterior to axilla nearly to the groin; in this two black bands, straight, oblique forward, extending some distance on to the dorsolateral surface, narrowed where they cross the lateral fold and more or less broadened and rounded at their inferior ends (shape of bands extremely variable, the second may have extension toward groin); dorsal caudal surface in male without black bands.

MEASUREMENTS OF THE TYPE.—Total length, 159 mm.; head and body to anus, 64; tail length, 95; tip of muzzle to posterior margin of ear, 16, to gular fold, 21; head width, 12.5; hind leg, 63; hind foot, 31; base of 5th to end of 4th toe, 25.

This species very possibly, in fact probably, intergrades with *Callisaurus ventralis ventralis* (Hallowell) north of the middle of the length of the Gulf side of the peninsula. I have no specimens, however, from localities where anything more than great variability in the southern species is shown. Heretofore, *Callisaurus plasticus*, new species, has been confused with *Callisaurus draconoides* Blainville. Cope's description is mainly from a specimen of the former, his drawings from a specimen of the latter. *C. draconoides* Blainville is limited to the Cape Region.

¹From *plasticus*, "fit for molding," with reference to the variable character of the species, especially conspicuous in the shape of the black lateroventral bands.

9. *Callisaurus splendidus*, new species

TYPE.—A. M. N. H. No. 5372, ♂. Collector, C. H. Townsend, Albatross Expedition, April 10, 1911.

PARATYPES.—A. M. N. H. Nos. 5338, 5342, 5373–5375, 5396.

TYPE LOCALITY.—Angel de la Guarda, Gulf of California, Lower California, Mexico.

SYNONYMS.—*Callisaurus ventralis*, Townsend, 1890, Proc. U. S. Nat. Mus., VIII, p. 144; *Callisaurus draconoides ventralis* (part), Cope, 1898 (1900), Rept. U. S. Nat. Mus., p. 273.

DIAGNOSIS.—Size medium, adults averaging between 150 and 160 mm., total length, probably seldom reaching 170. Hind leg in male somewhat shorter than head and body to anus, when folded forward along body little exceeding end of muzzle. Tail in male longer than head and body, never one and one-half times as long. Femoral pores 10–14, averaging 12 (8 specimens). Coloration light to dark, more or less vividly red over the whole dorsal surface as well as on gular region and anteroventral aspect of humerus. The 2 black bands on the lateroventral blue area neither large nor vivid; their position oblique forward with reference to lateral fold, the posterior of the two at its inferior end with tendency to extension backward toward the groin. Tail conspicuously banded below and above with black.

MEASUREMENTS OF THE TYPE.—Total length, 150 mm.; head and body to anus, 65 mm.; tail length, 85; tip of muzzle to posterior margin of ear, 15, to gular fold, 21; head width, 12.5; hind leg, 64; hind foot, 30; base of 5th to end of 4th toe, 24.5.

10. *Sceloporus lineatulus*, new species

TYPE.—A. M. N. H. No. 5478, ♂. Collector, C. H. Townsend, Albatross Expedition, May 16, 1911.

TYPE LOCALITY.—Santa Catalina Island, Gulf of California, Mexico.

DIAGNOSIS.—A robust species of medium size (length of head and body of adult male, 85 mm.), especially bristling with large, long-pointed but not spinous scales; 4–6 preauriculars in oblique row, relatively long and pointed, overlapping at bases; dorsal scales (7 straight longitudinal rows) much larger than ventrals; laterals crowded in oblique rows, graduated in size to meet ventrals, the shape changing through intermediate stages from angular, long-pointed, weakly denticulate scales to the rounded ventrals with their 2–4 equal points or scallops; rump and proximal caudals equal to dorsals; dorsals about 28 from interparietal to base of tail, 5 in head length (muzzle to interparietal); distance from base of 5th toe to end of 4th equal to length from tip of muzzle to anterior border of ear; femoral pores, 20. Coloration of adult male rufous dorsally, blue lateroventrally verging into green above, blue on chest between arms, and on chin; sides prominently marked from above arm to groin with about 11 longitudinal parallel brown lines following the direction of the scales; posterior gular region black, also black more or less as follows: on ventral arm, breast, median abdominal area, groin, ventral femur.

MEASUREMENTS OF THE TYPE.—Total length, 199 mm. +; head and body to anus, 85; tail length, 114 + (reproduced); tip of muzzle to posterior border of interparietal, 21, to posterior border of ear, 25, to base of throat, 25; greatest head width, 23, width at posterior orbital angle, 20, at anterior orbital angle, 13.5; hind leg, 61; base of 5th to end of 4th toe, 24.

This species, while very distinct, shows relationship with the forms known as *S. zosteromus* Cope and *S. magister* Hallowell.

SATOR, new genus

TYPE.—*S. grandævus*, new species.

DIAGNOSIS.—Body strongly compressed with high vertebral ridge in the adult; ziphisternal and poststernal ribs at acute angles with the vertebrae forming extremely long lateroventral loops nearly or quite to the groin and recurved to the mid-ventral line; a sternal fontanelle. Nostrils superior; lateral teeth tricuspid, no pterygoid teeth; labials segmental, superciliaries imbricated; head scales large, as in *Sceloporus* and *Uta*; tympanum exposed. Lateral area granular, extending high on shoulder and nape, strongly developed postauricular folds, and a well-developed lateral fold to the groin. Scales on posterior femur granular, also on exterior aspect of tibio-tarsal joint; also imbricated scales on knee and on dorsal aspect of tibia differentiated, smaller and larger respectively. A strong structural gular fold usually present, marked by differentiation of scales, homologous with anterior fold of *Holbrookia* and of the *Utas* which have two structural folds; a posterior fold possible, in some species indicated at the sides of the neck by a transverse extension of granules and 2 or more enlarged scales of a "denticulated border." Tail compressed, very long; caudal scales verticillate, obliquely keeled, dorsally at least with high sharp keels; long series of femoral pores; hind legs very long; digits with keeled lamellae inferiorly; enlarged postanals in male.

Cope in 1888 (Proc. U. S. Nat. Mus., p. 397, Pl. xxxvi, figs. 1a-g) described a new genus, *Lysoptychus* (type species *lateralis*, from one specimen collected at San Diego, Texas), supposed to be between *Uta* and *Sceloporus*, the distinctive character being a gular fold. But the fold in the specimen in question is not marked structurally; it is similar to the fold in *Callisaurus* and certain *Utas* resulting from looseness of skin in the gular region, without structural differentiation and disappearing when the head is bent to a horizontal with the body. *Lysoptychus* was not recognized by herpetologists and the specimen has been referred to *Sceloporus couchii* Baird (type, U. S. N. M. No. 2739, from Santa Catarina, Nuevo Leon, Mexico) (Stejneger and Barbour, 1917, Check List, p. 53).

The genus *Sator* represents what is evidently an ancestral form, kept in existence through isolation under favorable conditions in a relatively unchanging habitat. It combines the compressed body and long compressed tail of arboreal types with many of the characters of the primitive terrestrial genus *Sceloporus*, and also with characters, such as the anterior and posterior gular folds, diagnostic of very different terrestrial forms like the *Utas* and the *Holbrookias*.

A connection of the new genus with *Sceloporus* exists in a Mexican species, *S. utiformis* Cope, 1864, from Colima (a series of which is at

hand, A. M. N. H. Nos. 12745–12752, Colima, Mexico, 1919). This species has no neck fold of any sort but it has characters—the lateral granulation, lateral fold, and scale differentiation of the posterior extremities—which relate it definitely to *Sator* as well as to *Uta*. Careful study of the skeleton may place this species under *Sator*

11. *Sator angustus*,¹ new species

TYPE.—A. M. N. H. No. 5712, ♂. Collector, C. H. Townsend, Albatross Expedition, April 17, 1911.

PARATYPES.—A. M. N. H. Nos. 5713–5723.

TYPE LOCALITY.—Santa Cruz Island, Gulf of California, Mexico.

DIAGNOSIS.—A striking looking lizard with compressed body in the adult, high along vertebral line, and with very long and strongly compressed slender tail; bears close general resemblance to *Sator grandævus*, new species, but differs in greater size, reaching a total length of 300 mm., in coloration and pattern, in lacking the posterior gular fold at the sides of the throat, in having scales of head and nape in the adult more tubercular; also the tail more strongly compressed, with the 4–6 dorsal caudal rows quite to the end of the tail bearing high, sharp, and spine-tipped scales. Dorsals average 70 from interparietal to base of tail, 14–15 in a head length; femoral pores average 13. General coloration light or dark, brown or olivaceous; color pattern includes dark shoulder patches.

12. *Sator grandævus*, new species

TYPE.—A. M. N. H. No. 5491, ♂. Collector, C. H. Townsend, Albatross Expedition, April 19, 1911.

PARATYPES.—A. M. N. H. Nos. 5492–5496.

TYPE LOCALITY.—Cerralvo Island, Gulf of California, Mexico.

DIAGNOSIS.—A relatively large lizard reaching a total length of 250 mm., more than two-thirds of which is the strongly compressed tail with verticils of strongly keeled mucronate scales; body compressed and with high vertebral ridge in the adult; a strong lateral fold from postauricular region to groin; broad, uninterrupted band of granules along lateral fold, broadest at shoulder, meeting keeled dorsal scales more or less abruptly throughout its length; a strong structural anterior gular fold, marked by differentiation of scales; posterior gular fold visible laterally, marked by an intrusion of granules ventralward and 3 enlarged scales of a “denticulated border”; about 60 scales between interparietal and base of tail, 16 in a head length; femoral pores average 18. General coloration light or dark grayish blue; color pattern includes black shoulder patches (sometimes nuchal collar).

MEASUREMENTS OF THE TYPE.—Head and body, 70 mm.; tail, 137 + (reproduced); head length, 18.5; head width, 15; tip of muzzle to anterior fold, 22; tip of muzzle to posterior fold (at side of head), 25.5; hind leg, 55; base of 5th to end of 4th toe, 22. The measurement of No. 5492 in which the tail has not been reproduced is as follows: total length, 258 mm.; head and body, 75; tail, 183.

¹With reference to the very narrow, compressed body in the adult.

MEASUREMENTS OF THE TYPE.—Head and body to anus, 89 mm.; tail, 136 + (reproduced; measurement of small specimen with uninjured tail, No. 5719, head and body to anus, 68, tail, 160); total length, 225 (if allowance be made for injured tail, total length, 300 mm.); head length, 22; head width, 19; tip of muzzle to anterior gular fold, 27; hind leg, 65; base of 5th to end of 4th toe, 23.

13. *Uta concinna*, new species

TYPE.—A. M. N. H. No. 5396, ♂. Collector, C. H. Townsend, Albatross Expedition, March 10, 1911.

PARATYPES.—A. M. N. H. Nos. 5399-5413.

TYPE LOCALITY.—Cerro Island, Lower California, Mexico.

SYNONYMS.—*Uta stansburiana*, 1898 (1900), Rept. U. S. Nat. Mus., p. 310; *Uta stansburiana*, 1915, Proc. U. S. Nat. Mus., XLVIII, p. 413, ♀. Check List, p. 52.

DIAGNOSIS.—Reaching considerable resemblance in scutellation to *Uta stansburiana*; maximum total length, 115 mm., average about 100 mm.; head length, 13.5; head width, 10.5; tip of muzzle to anus, 16; tip of muzzle to posterior border of ear, 13.5; to gular fold, 16; median line to lateral line, 15; dorsals 85 between interorbital and base of tail, ventrals 60 from base of tail to anus. The dorsal pattern of the male is common in adult males; the dorsal pattern of the female consists of a series of short, oblique, white bands along the dorsolateral line, bordered anteriorly with black; postaxillary spot posterior in position, not concealed by the adpressed elbow, very large and conspicuous in both sexes.

MEASUREMENTS OF THE TYPE.—Total length, 115 mm.; head and body to anus, 48; tail length, 67; tip of muzzle to posterior border of ear, 13.5, to gular fold, 16; head width, 10.5; hind leg, 36; hind foot, 17.

14. *Uta mannophorus*,¹ new species

TYPE.—A. M. N. H. No. 5447, ♂. Collector, C. H. Townsend, Albatross Expedition, April 5, 1911.

PARATYPES.—A. M. N. H. Nos. 5440-5446, 5448 (6 ♂♂, 2 ♀♀).

TYPE LOCALITY.—Carmen Island, Gulf of California, Mexico.

SYNONYMS.—*Uta stansburiana* (part), Cope, 1898 (1900), Rept. U. S. Nat. Mus., p. 310, *Uta stansburiana elegans* (part), Stejneger and Barbour, 1917, Check List, p. 52.

DIAGNOSIS.—A stout-bodied *Uta* reaching a total length of 150 mm.; dorsal scales small, not so large as brachials, 13-15 rows from median line to lateral granules; brachials thick and weakly keeled, not greatly larger than scales at middle of rump; dorsals 105 (in type) from interparietal to base of tail, ventrals 65 from denticulated collar to anus; femoral pores little variable, averaging 15; a series of juxtaposed black spots across the shoulders forms a scalloped collar; spots (bright blue) of sexually dimorphic dress of male unusually large (5-7 dorsals, 10-15 lateral granules); males with much dark blue ventrally, postaxillary spot faint, or lacking.

¹Named from the scalloped collar across the shoulders.

MEASUREMENTS OF THE TYPE.—Total length, 149 mm.; head and body to anus, 54; tail length, 95; tip of muzzle to posterior margin of ear, 14, to gular fold, 18; head width, 11; hind leg, 40; hind foot, 20.

15. *Uta parva*, new species

TYPE.—A. M. N. H. No. 5428, ♂. Collector, C. H. Townsend, Albatross Expedition, March 13, 1911.

PARATYPES.—A. M. N. H. Nos. 5427 ♀, 5429, 5431–5433.

TYPE LOCALITY.—San Bartolome Bay, Lower California, Mexico.

DIAGNOSIS.—A very small, fine and smooth-scaled = *Uta* of the *Stansburiana* group, with tail twice length of head and body. Dorsal scales small, keeled, somewhat tubercular, well differentiated from lateral granules; dorsals average about 100 between interparietal and base of tail, very much smaller than brachials, 13–15 rows from median line to lateral granules; brachials more or less weakly keeled, about equal to scales on rump and very much more pointed. Head brown, dorsal color pattern an all-over arrangement of small blue spots in male, in female transverse series of long and wavy dark lines bordered behind with light, sometimes connected with a series of white transverse lines on the lateroventral blue surface; gular region anterior to collar deep blue in male; postaxillary spot of medium size, largely concealed by adpressed elbow.

MEASUREMENTS OF THE TYPE.—Total length, 101 mm. +; head and body to anus, 43; tail length, 58 + (reproduced, length of tail of No. 5431 of which head and body length is 44, 80); tip of muzzle to posterior border of ear, 11.5, to gular fold, 14.5; head width, 9.5; hind leg, 42; hind foot, 17.

16. *Uta squamata*,¹ new species

TYPE.—A. M. N. H. No. 5424, ♂. Collector, C. H. Townsend, Albatross Expedition, May 16, 1911.

PARATYPES.—A. M. N. H. Nos. 5421–5423, 5425–5426.

TYPE LOCALITY.—Santa Catalina Island, Gulf of California, Mexico.

DIAGNOSIS.—A small lizard not exceeding 135 mm., with the general appearance of the members of the *Uta stansburiana* group, but distinguished at once by the uniformity and large size of the imbricated dorsal scales (everywhere distinctly separable from the lateral granules, about equal to the brachials, 10–11 from median line to lateral granules), coupled with still greater coarseness of the femorals and tibials, and of the caudals on thickest part of the tail. Dorsals 72–76 from the interparietal to the base of the tail, 63 ventrals from denticulated collar to anus; femoral pores 13–16, averaging 15. General coloration olivaceous, males with the typical adult *Uta* all-over pattern of fine dots; ventral surfaces everywhere blue, no postaxillary spot but wide ventrolateral bluish black band from axilla to groin.

MEASUREMENTS OF THE TYPE.—Total length, 135 mm.; head and body to anus, 52; tail length, 83; tip of muzzle to posterior margin of ear, 14, to denticulated gular fold, 19; head width, 11.5; hind leg, 39; hind foot, 20.

¹With reference to the imbricated dorsal scales of unusually large size and the coarseness of femorals and tibials.

17. *Verticaria esarules*, new species

TYPE.—A. M. N. H. No. 5517. Collector, C. H. Townsend, Albatross Expedition, April 5, 1911.

PARATYPES.—A. M. N. H. Nos. 5516, 5518–5520.

TYPE LOCALITY.—Carmen Island, Gulf of California, Mexico.

DIAGNOSIS.—Bearing in general close resemblance to *Verticaria sarices* (Van Denburgh), of San José Island, but with longer muzzle, somewhat shorter hind legs, frontal not in complete contact with second supraocular (because of interposition of granules), lighter general and dorsal coloration, and bright blue color not only ventrally but high laterally on head and neck, body, extremities, and tail, as well as on dorsal aspect of tail, at least distally.

MEASUREMENTS OF THE TYPE.—Total length, 183 mm.; head and body to anus, 55; tail, 128; head length to gular fold, 20, to posterior margin of ear, 15; head width, 8.5; hind leg, 35.

18. *Cnemidophorus celeripes*,¹ new species

TYPE.—A. M. N. H. No. 5514. Collector C. H. Townsend, Albatross Expedition, 1911.

PARATYPE.—A. M. N. H. No. 5515, immature.

TYPE LOCALITY.—San José Island, Gulf of California, Mexico.

DIAGNOSIS.—A very ornamental, conspicuously black and white patterned species of *Cnemidophorus* above medium size, largest specimen at hand measuring 382 mm., tail more than two-thirds total length. It has very fine uniform dorsal scutellation, abdominal ventrals in 8 longitudinal rows (30–32 transverse); frontoparietals separate; nostril anterior to nasal suture. The nasal is not in contact with the second supralabial; scales on extreme edge of posterior neck fold small at least at middle, the largest exceeding enlarged scales at center of gular region, greatly smaller than scales on chest; 4 supraoculars; 8 femoral rows of enlarged scales, 5 tibial, 7 brachial, 3 antebrachial; scales on underside of forearm, posterior aspect, scarcely enlarged; femoral pores 20–23.

Coloration of adult six wide longitudinal bands of white tinged with olive, alternating throughout their length with 5 wide chains of round black spots more-connected anteriorly, separated into the individual black spots posteriorly and in the dorsolateral chains; somewhat irregular tessellated effect of wide black markings along the sides adjoining the ventrals, extending forward over postauricular area; throat marked by 2–4 transverse bands of black, the one between inferior margins of the ear openings particularly prominent; 2 parallel oblique black bars reach downward and forward, outlining the sublabials (often interrupted in immature); extremities with irregular coarse network of black on the very light olive background; nape, head, and tail more brown; dorsal tail vivid light rose color distally and throughout its length ventrally; the same color on posterior aspects of femur, forearms, ventral surface of hind legs, and in the adult male from the chest between the forelegs forward over fold and gular region to the sublabials; breast and abdominal region blue with 7 longitudinal narrow black lines made by the juxtaposed pigmented margins of the scales.

¹"Swift-footed," with reference to its adaptability for very great speed.

The immature are black with 6 narrow white stripes dorsally (lowest on a line with the ear), lateral space black with irregular oblique and vertical white bars. In the development of the adult pattern, minute white spots appear above the lowest white stripe and widen to connect with it, scalloping the lower edge of the black band above; minute white spots appear in the median black band and spread obliquely, alternate ones in opposite directions to meet the adjoining white stripes, converting the median straight black band into a waved one and eventually by a deepening of the curves into a chain of round black spots; minute transverse extensions of white along the lower margin of the dorsal white stripe of each side, and similarly along upper and lower margins of the dorsolateral white stripe, scallop in a similar way the black bands adjoining, converting these also into chains of round black spots.

MEASUREMENTS OF THE TYPE.—Total length, 295 mm. +; head and body to anus, 90; tail length, 205 + (reproduced); tip of muzzle to collar, 31; shielded head, or to anterior border of ear, 22.5, to posterior border, 25; greatest head width, 15, width at posterior angle of orbit, 11, at anterior angle, 8.5; hind leg, 67; base of 5th to end of 4th toe, 31. The ratios of foot to head measurements in the type do not hold good in the adult male. In a male of 102 mm. head and body length, base of 5th to end of 4th toe is 33 mm., muzzle to collar, 40, greatest head width, 19.

The range of this species probably includes the mainland of Lower California along the Gulf northward from La Paz and San José Island. It is probably the species in the collections of the Muséum d'Histoire Naturelle, from Santa Rosalia and Mulege, identified by Mocquard (1899, *Nouv. Arch. du Muséum d'Hist. Nat.*, (4) I, p. 315) as *Cnemidophorus grahamii* Baird and Girard (type from Texas, 1852).

19. *Cnemidophorus disparilis*,¹ new species

TYPE.—A. M. N. H. No. 5527. Collector, C. H. Townsend, Albatross Expedition, April 12, 1911.

PARATYPES.—A. M. N. H. Nos. 6884–6885, immature.

TYPE LOCALITY.—Tiburon Island, Gulf of California, Mexico.

DIAGNOSIS.—Of medium size; with fine and uniform dorsal scutellation, abdominal ventrals in 8 longitudinal rows; head depressed; frontoparietals separate, nostril anterior to nasal suture. The nasal is not in contact with the second supralabial; scales on posterior collar of considerable size, scarcely larger than enlarged scales at center of gular region, margin of fold with 1–4 rows of minute scales; 4 supraoculars; 6 femoral rows of enlarged scales, 3 tibial (of great size in two anterior rows), 7–8 brachial, 3 antebrachial; underside of forearm with narrow band of enlarged scales on posterior aspect; femoral pores, 19. General coloration in adult orange-brown dorsally, ventrally blackish over all surfaces, even of the feet. Color pattern 7–9 extremely narrow, orange-brown longitudinal lines, straight or wavy, alternating with black lines of similar narrowness; brilliant color obscured by blackish anteriorly; sides ornamented with orange spots more or less in vertical rows

¹With reference to the coloration of the immature, at present unlike anything known in the genus outside of this species and its very close relative, *C. martyris*.

bordered anteriorly with black; the mottling with orange-brown and black extends over sides of head; the throat is crossed by 2-3 narrow bars of intense black; mid-ventral caudal line marked by a double series of small black spots.

The immature of this species is black everywhere ventrally; black also on the sides, brown on the back, with closely set pin-points of orange-yellow, verging to white laterally, on exposed surfaces of body and extremities; head and tail unspotted and lighter in general coloration; an unspotted mid-dorsal area, broad on nape and narrowing to a point opposite the elbows.

MEASUREMENTS OF THE TYPE.—Total length (tail broken off 30 mm. from base, with regeneration just begun); head and body to anus, 87 mm.; end of muzzle to collar, 30; tip of muzzle to anterior ear, 20; greatest head width, 12, across anterior angle of orbits, 8.5; hind leg, 54; base of 5th to end of 4th toe, 23.5.

MEASUREMENTS OF No. 6884.—Total length, 144 mm.; head and body to anus, 42; tail length, 102; tip of muzzle to posterior gular fold, 17, to anterior ear, 12, to interparietal, 9, to fore limb, 18; greatest head width, 7, width across posterior supraoculars, 6; collar to anus, 25; hind leg, 28.

It would seem likely from the discovery of this rare species on Tiburon Island with immature very like the type of *C. martyris* Stejneger, 1891, that the latter species was described from immature forms only. The different general coloration in the two, lack of enlarged scales on the ventral aspect of the forearm of *martyris*, and the variation in corresponding measurements of *C. martyris* and the paratype of *C. disparilis* indicate that the species are distinct—as we should expect as a result of development of forms isolated on the two widely separated islands, Tiburon and San Pedro Martir, in a region unfrequented by man.

20. *Cnemidophorus estebanensis*, new species

TYPE.—A. M. N. H. No. 5571. Collector, C. H. Townsend, Albatross Expedition, April 13, 1911.

TYPE LOCALITY.—San Esteban Island, Gulf of California, Mexico.

DIAGNOSIS.—Bearing close resemblance to *C. melanostethus* Cope and *C. punctilinealis*, new species, but very greatly more elongated than the latter for a given girth and development of color pattern, and with longer head and foot measurement than the former. It differs from *punctilinealis* in having the scales on the underside of the forearm considerably enlarged, the dorsal granules smaller, more elongated, set closer together (4 instead of $2\frac{1}{2}$ to a millimeter). It differs from both in the small size and large number of rows of brachials and femorals, 8 and 8 respectively.

MEASUREMENTS OF THE TYPE.—Total length, 175 mm. + (tail reproduced); head and body to anus, 76.5; tail length, 98.5+; tip of muzzle to collar, 26, to anterior border of ear, 19; greatest head width, 11; hind leg, 55; base of 5th to end of 4th toe, 26.

C. melanostethus (A. M. N. H. No. 2525 from Tucson. Collector, M. C. Dickerson, 1912), with equal head and body length, has head length to fold, 25 mm., to anterior border of ear, 17, and length of 4th toe from base of 5th, 23.5 mm.

It is always unfortunate that a species should be described from one specimen only, especially in *Cnemidophorus* where evolution of the color pattern, both the method, and time in the developmental history of the lizard, furnishes one of the strongest diagnostic characters. A series of specimens from San Esteban is needed before a complete diagnosis of the color pattern can be given.

21. *Cnemidophorus punctilinealis*,¹ new species

TYPE.—A. M. N. H. No. 5532, adult, ♂. Collector C. H. Townsend, Albatross Expedition, April 12, 1911.

PARATYPES.—A. M. N. H. Nos. 5526, 5535, 5533 (immature to adult, showing development of color pattern), also A. M. N. H. Nos. 5528–5531, 5534, 5536–5539.

TYPE LOCALITY.—Tiburon Island, Gulf of California, Mexico.

DIAGNOSIS.—A teiid lizard of medium size, the largest specimen in a collection of 13, measuring 335 mm. (with tail about two-thirds the total length); closely related to *C. melanostethus* Cope. It has relatively uniform dorsal scutellation, abdominal ventrals in 8 longitudinal rows, frontoparietals separate, nostril anterior to nasal suture. The nasal is not in contact with the second supralabial; scales on posterior neck fold scarcely exceeding largest at center of gular region, 1–2 rows very small at extreme margin; 4 supraoculars; there are 7 femoral rows of enlarged scales, 3 tibial, 6 brachial, 2 antibrachial (with part of a third proximally), the superior antibrachial row and anterior tibial row extremely large; underside of forearm has scales along median line scarcely enlarged; femoral pores 20.

The final stage in the development of the color pattern gives an arrangement, from ventral scales to ventral scales, of 11 quite regular longitudinal rows of closely set minute black spots (dots, 1–5 granules large), on an olivaceous background lighter laterally—without trace of longitudinal lines or bands; the dots continue over the dorsal surface of the extremities, and are carried forward in more irregular arrangement and greater size over the sides of the head and the gular region, sometimes over the dorsal head; the breast, undersurface of arms, and the posterior gular fold are blackish in the male, often anterior gular region also black; the same linear arrangement of dots may extend conspicuously nearly one-half the length of the tail; remainder of ventral surfaces (except tibiae and feet) light to dark bluish gray, with the ventrals black-margined and a double series of black spots occupying the mid-ventral caudal line; tail reddish to purplish brown distally.

Immature with 4 equidistant longitudinal light lines dorsally, between each two of which appears an irregular more or less double series of minute light spots; spots and vertical bars of lighter color closely cover the sides and extend forward on sides of head and gular region. By a process involving an increase in width of the irregular light spots of the back until they meet the light dorsal lines, 3 series of broader than long, small, pigmented bars are left. By reduction of these in size and crosswise division of the lateral bars (2 rows on each side) the adult pattern of 11 longitudinal rows of black dots comes into existence.

¹With reference to the adult color pattern of dots which follow one another in close series.

MEASUREMENTS OF THE TYPE.—Total length, 313 mm.; head and body to anus, 85; tip of muzzle to collar, 29, to anterior border of ear, 22; greatest head width, 14.5, width at posterior angle of orbit, 12, at anterior angle of orbit, 9; hind leg, 65; base of 5th to end of 4th toe, 29.

Cnemidophorus punctilinealis, new species, compared with *C. melanostethus* Cope, attains advanced stages in the somewhat similar series of color patterns (with appearance of the black spots and elimination of the longitudinal stripes) at very much earlier periods in the development. The two species can always be distinguished by the very different color pattern of the sides, and by the longer head and foot of *C. punctilinealis*.

C. punctilinealis is represented in the W. W. Brown collection of the Museum of Comparative Zoology by one half-grown specimen (Field No. 785) from Guaymas on the coast of the Mexican mainland.

22. *Cnemidophorus bartolomas*, new species

TYPE.—A. M. N. H. No. 5508. Collector, C. H. Townsend, Albatross Expedition, March 13, 1911.

PARATYPES.—A. M. N. H. Nos. 5507, 5509, San Bartolome Bay; 5522, Abrejos Point, Ballenas Bay.

TYPE LOCALITY.—San Bartolome Bay, Lower California, Mexico.

DIAGNOSIS.—A very long-tailed species of medium size. Dorsal scutellation uniform (somewhat coarse, 2 granules to the millimeter), 8 rows of abdominal ventrals, nostril anterior to suture, 4 supraoculars, 2 frontoparietals, a long series of femoral pores (16-19). The collar is margined with small scales about size of posterior gulars, but has 4-5 rows enlarged at the middle anterior to these, 3-4 of which equal the largest central anterior gulars; great variability in arrangement of scales about nasal, nasal sometimes in contact with the second supralabial. Brachials, 6; antebrachials 4, those in the first posterior row small, in second posterior row of moderate size; scales underside forearm posterior aspect not enlarged; femorals 7-8; tibiales 3. General coloration light olive dorsally, browner on head and tail; bluish white ventrally, spotted irregularly with black from the sides of the head and gular region out on to the tail. Dorsal pattern 5 longitudinal light stripes within area continuous with space between temporal angles; dark bands between these stripes cut crosswise into spots by development of light cross-stripes; these light cross-stripes in the two dorsal bands alternate with one another, thus converting the median light longitudinal stripe into a zigzag stripe and leaving the black spots in the 2 dorsal rows alternate with one another. Black markings both dorsal and lateral moderate and relatively uniform in size and intensity, giving an effect of considerable neat regularity in longitudinal (8-10) and transverse (about 25) rows, notwithstanding their very great diversity in shape. Pattern, both stripes and spots, obscured posteriorly.

MEASUREMENTS OF THE TYPE.—Total length, 304 mm.; head and body to anus, 82; tail length, 222; collar to anus, 55; tip of muzzle to collar, 27, to posterior ear, 225; to posterior margin of interparietal, 205; tip of muzzle to axilla, 33.5; head width at posterior orbital angles, 12, at anterior orbital angles, 9; hind leg, 58; length of 4th toe from base of 5th, 28.

23. *Cnemidophorus vandenburghi*,¹ new species

TYPE.—A. M. N. H. No. 5521. Collector, C. H. Townsend, Albatross Expedition, April 2, 1911.

TYPE LOCALITY.—Carmen Island, Gulf of California, Mexico.

DIAGNOSIS.—A small species related to *Cnemidophorus rubidus* (Cope) and *Cnemidophorus celeripes*, new species. Nasal not in contact with the second supraocular; posterior of the 4 supraoculars extremely small; all of the collar scales small except 6–10 at the middle, 2 or 3 of which may exceed the central anterior gulars. Brachials, 5–6, antebrachials, 3 (exterior row conspicuously broad), scales on underside of forearm posterior aspect somewhat enlarged; femorals, 6–7, tibials, 3; femoral pores, 21.

Head brown, not conspicuously spotted. gular region yellow, cross-banded with black and bright blue. Olivaceous dorsally, with 4 longitudinal light stripes between the temporal angles (alternating with longitudinal series of black and olive spots or bars), 6 longitudinal light stripes, counting the one stretching from postauricular area to groin on each side; median space between the two mid-dorsal light stripes twice as broad as the other spaces; black spots very irregular in shape, not opposite each other in the dorsal rows, and the whole effect of the pattern one of confused and crowded elements (in contrast with *rubidus* and *celeripes*); black lateral markings more nearly opposite than the dorsal, more regular in size and shape; pattern reduced on nape and rump. Bright blue ventrally on breast and abdomen without spots or stripes, also bright blue laterally on head, body, extremities, and tail; no spots or stripes on ventral surfaces of extremities and tail; dorsal caudal surface red distally and ventral surface red for the whole length.

MEASUREMENTS OF THE TYPE.—Total length, 217 mm.; head and body to anus, 65; tail length, 152; tip of muzzle to gular fold, 24.5, to anterior ear, 17, posterior ear, 19, to posterior margin of interparietal, 17.5, to axilla, 31; head width at posterior orbital angles, 10, anterior orbital angles, 7; hind leg, 42; 4th toe to base of 5th, 21.5.

¹Named for Dr. John Van Denburgh, of the California Academy of Sciences, whose name is more closely connected with the herpetology work in Lower California than that of any other herpetologist.



**Article XI—MOLLUSCA OF THE CROCKER LAND EXPEDITION
TO NORTHWEST GREENLAND AND GRINNELL LAND¹**

BY FRANK COLLINS BAKER

NATURAL HISTORY MUSEUM, UNIVERSITY OF ILLINOIS

PLATES XXV TO XXVII

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¹Scientific Results of the Crocker Land Expedition.
Contribution from the Museum of Natural History, University of Illinois, No. 4.

INTRODUCTION

The collection brought back by the Crocker Land Expedition consists of several hundred specimens, both dry and preserved in alcohol. It includes all of the mollusks collected excepting the Cephalopoda. The absence of minute species, such as *Bela*, *Cylichna*, *Rissoa*, *Nucula*, etc., is noteworthy, as dredging could not have been done in the neighborhood in the deeper water west of the coast, in order that some material so abundant in beach débris might have been obtained living. However, the difficulties of making zoological investigations in these latitudes are very great, owing to climatic and other physical causes. Messrs. Ekblaw and Tanquary are to be congratulated for securing the amount of interesting material brought back. With all the handicaps incident to an Arctic expedition they obtained many species not before recorded from this northern land, and the results of a study of the collection have added considerably to our knowledge concerning the distribution of Arctic mollusks.

Acknowledgments are due the following gentlemen and institutions for assistance during the preparation of the paper:

Dr. Wm. H. Dall, United States National Museum; Mr. W. Elmer Ekblaw, University of Illinois; Dr. J. S. Kingsley, University of Illinois; Boston Society of Natural History; John Crerar Library, Chicago; Mr. Roy W. Miner, American Museum of Natural History, New York.

My thanks are due The American Museum of Natural History for the privilege of working up the collection.

The photographs of *Astarte* and *Buccinum*, plates XXV and XXVI, were made by Mr. Arthur G. Eldredge, of the University of Illinois.

THE PLACES OF COLLECTION OF MOLLUSCA BROUGHT BACK BY THE
CROCKER LAND EXPEDITION

BY W. ELMER EKBLAW

The collections of mollusks were made at rather scattered localities and at different times by Dr. M. C. Tanquary and me. The collections at Peeawahto Point and in Foulke Fjord, Umanak or North Star Bay, and Etah were made by Dr. Tanquary and me; those at Camp Etookashoo on Fosheim Peninsula, Cañon Fjord, and Sondre Upernivik were made by me. A few specimens were secured by Dr. E. O. Hovey.

Foulke Fjord, Peeawahto Point, and Etah are really but one habitat. Foulke Fjord is the deep inlet on the north bank of which are situated Etah and Peeawahto Point. Foulke Fjord lies in latitude $78^{\circ} 20' N.$ and is the first considerable indentation on the Greenland side south of Smith Sound. It is about seven miles in total depth and the depth of the water is generally over 100 fathoms. At its head a rather large brook empties into it from the lake at the foot of the glacier which debouches about two miles from the shore. Several small mountain brooks pour their cold waters into it from the sides; but all these streams are open only for two or three months.

Most of the bottom of Foulke Fjord is of rock-ledges or of chaotic pavements of rock over which it is difficult to dredge, except near the head of the Fjord where the rock is fairly well covered by the sediments brought down by the stream. Only a small part of the specimens were obtained by dredging.

The Etah locality, which lies approximately three miles within Foulke Fjord, is a flat crescentic terrace along the shore of a small cove. Except at the ebb of the very lowest tides it is submerged and forms the habitat of numerous mollusks. At its widest point it is about 100 meters wide. It is covered by rocks and boulders, with a few scattered small patches of coarse gravel.

Peeawahto Point lies two miles farther within the Fjord. It is a talus slope of gentle gradient that extends from about 200 feet above the shore out under the waters of the Fjord. It is a rocky locality but, because of its rather gentle slope, the belt of fairly shallow water is relatively broad. The mollusks obtained at this locality were collected from the ice as it melted in the early summer.

Umanak or North Star Bay lies fifteen miles within Wolstenholme Sound in latitude $76^{\circ} 30' N.$, about 125 miles south from Etah. The mollusks from the locality were collected in large measure from the

sandy, gravelly shores of North Star Bay. This bay is rather shallow with large areas of sand covering most of the bottom. In places rock- ledges project through the sand, and these are generally overgrown by *Laminaria* sp. Three large fresh-water streams discharge into this bay.

Camp Etookashoo, on the northern point of Fosheim Peninsula, faces out upon Greely Fjord and Fridtjof Nansen Sound, in latitude $81^{\circ} 30' N$. It is a low flat point of gentle gradient upon which the ridges of gravel piled up by the ice of former shore-lines enclose lagoons of shallow water. The shells were collected from several of these ridges, wherever this wind had blown them somewhat free of snow. The waters washing this point open directly upon the Arctic Ocean.

Cañon Fjord is a deep fjord emptying out upon Greely Fjord. The specimens in the collection from this locality were gathered on the shores of a flat, sandy delta of a rather large stream near the head of the fjord in latitude $80^{\circ} 45' N$. Because of the large amount of sand blown upon the ice by the heavy winds of winter the ice melts early about this delta, with a consequent large pool of open water about the mouth of the stream.

A few specimens from Sondre Upervik were gathered on the shingly shores of a small cove along the sound between Ingnerits Peninsula and Kekertorsuak in latitude $72^{\circ} 10' N$. The rocks and shingle of the shallow water along the shore are densely covered with these mollusks.

COMPARISON WITH COLLECTIONS MADE BY PREVIOUS EXPEDITIONS

The Mollusca of Greenland have long attracted the attention of conchologists and zoologists, collections having been made before the publication of the *Systema* of Linnæus. The territory covered by the Crocker Land Expedition, however, has been visited but few times by the naturalist. Two exploring parties to this region which brought back more or less extensive collections of marine Mollusca may be especially mentioned for comparison with the collection made by the Crocker Land party.

In 1859-1860, Dr. I. I. Hayes made a voyage in the schooner 'United States' and explored parts of Grinnell Land and the region about Foulke Fjord. Dr. Hayes brought back a large collection of marine invertebrates (69 species) which were collected at Port Foulke, Littleton Island, Cape Faraday, and Godhavn. The highest point from which shells were collected was Port Foulke, in about $78^{\circ} 30'$, north latitude. Of this material Stimpson (1863, p. 138) says:



The collections of Dr. Hayes, as might be expected from the thorough search to which the Arctic regions have lately been subjected, and the characteristic paucity of forms existing there, embrace few novelties. They possess, however, great interest, from having been found in great part at localities much nearer the Pole than any previous expeditions have succeeded in reaching on the American side of the Arctic circle. They include some species hitherto found only on the European side. And, we may add, the number of species collected by Dr. Hayes is greater than that brought back by any single expedition which has yet visited those seas, as far as can be judged by published accounts.

Twenty-one species are listed by Stimpson (1863). Of these, five species were from Port Foulke and were also collected by the Crocker party. Of the twenty-one species listed, fourteen are represented in the material collected by Ekblaw and Tanquary.

In 1875-1876, Sir G. S. Nares visited the Polar sea in the ships 'Alert' and 'Discovery.' The party reached a latitude of $83^{\circ} 20'$ and obtained a large collection of mollusks, thirty-four species, from Grinnell Land and vicinity (Smith, 1877). Fossils were collected by Captain Feilden, naturalist to the expedition, at twenty-seven different localities, twenty-four species being certainly identified from this material (Jeffreys, 1877; Feilden, 1877). The results of the Hayes and Nares expeditions, as compared with those of the Crocker Land Expedition, are shown in Table I.

TABLE I.—COMPARISON OF SPECIES COLLECTED BY THREE ARCTIC EXPEDITIONS¹

SPECIES	BAKER	SMITH	FEILDEN	STIMPSON
<i>Tonicella marmorea</i> (Fabricius).....	×	×	—	—
<i>Leda pernula</i> (Müller).....	×	×	—	—
<i>Leda pernula falcata</i> Jeffreys.....	—	—	×	—
<i>Leda minuta</i> (Müller) variety.....	—	×	—	×
<i>Yoldia glacialis</i> (Gray).....	—	×	×	—
<i>Yoldia frigida</i> (Torrell).....	—	—	×	—
<i>Yoldia arctica</i> (Gray).....	—	—	×	—
<i>Nucula inflata</i> Hancock.....	—	×	—	—
<i>Pecten grænlændicus</i> Sowerby.....	×	×	×	—
<i>Pecten islandicus</i> Müller.....	—	—	—	×
<i>Mytilus edulis</i> Linné.....	×	—	—	×
<i>Musculus lævigatus</i> (Gray).....	×	×	—	×
<i>Musculus substriatus</i> (Gray).....	×	—	—	—
<i>Crenella faba</i> (Müller).....	×	—	—	×
<i>Thracia obliqua</i> Jeffreys.....	—	—	×	—
<i>Lyonsia arenosa</i> (Möller).....	—	×	—	—
<i>Neera suborta</i> G. O. Sars.....	—	—	×	—
<i>Astarte borealis</i> (Schumacher).....	×	×	×	×
<i>Astarte borealis sericea</i> Posselt.....	×	—	—	—
<i>Astarte crenata</i> (Gray).....	×	—	—	—
<i>Astarte crenata inflata</i> Hägg.....	×	—	—	—
<i>Astarte arctica</i> (Gray).....	×	—	—	—
<i>Astarte fabula</i> Reeve.....	×	×	×	—
<i>Astarte elliptica</i> (Brown).....	—	—	—	×
<i>Astarte striata</i> (Leach).....	—	×	—	×
<i>Astarte warehami</i> (Hancock).....	—	×	—	—
<i>Azinus gouldii</i> Philippi.....	—	×	×	—
<i>Cardium islandicum</i> Linné.....	—	×	×	—
<i>Cardium haysii</i> Stimpson.....	—	—	—	×
<i>Serripes grænlændicus</i> (Gmelin).....	×	—	—	×
<i>Macoma clacarea</i> (Gmelin).....	×	×	×	×
<i>Mya truncata</i> Linné.....	×	×	×	—
<i>Mya truncata uddevallensis</i> Forbes.....	×	—	—	×
<i>Saxicava arctica</i> (Linné).....	×	×	×	×
<i>Siphonodentalium vitreum</i> G. O. Sars.....	—	—	×	—
<i>Cylichna alba</i> (Brown).....	—	×	×	—
<i>Cylichna striata</i> (Brown).....	—	×	—	—
<i>Limacina helicina</i> (Phipps).....	×	—	—	×
<i>Clio limacina</i> (Phipps).....	×	—	—	—

¹The first column represents the Crocker Land Expedition, the second column the recent shells of the Nares Expedition, the third column the fossil shells of the same expedition, and the fourth the Hays Expedition. The recent nomenclature is used in this table.

SPECIES	BAKER	SMITH	FEILDEN	STIMPSON
<i>Coryphella salmonacea</i> (Couthouy).....	—	×	—	—
<i>Onchidiopsis grænlandicus</i> Bergh.....	—	×	—	—
<i>Tectura rubella</i> (Fabricius).....	×	—	—	—
<i>Lepeta cæca</i> (Müller).....	×	×	—	—
<i>Margarites helicina</i> (Phipps).....	×	—	—	×
<i>Margarites vahlæi</i> (Müller).....	×	—	—	—
<i>Margarites cinerea</i> (Couthouy).....	×	—	—	×
<i>Margarites glauca</i> (Möller).....	—	×	—	—
<i>Margarites umbilicalis</i> Brod. and Sowb.	×	×	×	—
<i>Margarites umbilicalis spiralis</i> Baker.....	×	—	—	—
<i>Margarites</i> species.....	—	×	—	—
<i>Solariella lævis</i> Friele.....	×	—	—	—
<i>Natica affinis</i> (Gmelin).....	—	×	—	—
<i>Natica clausa</i> Brod. and Sowb.....	—	—	—	×
<i>Velutina zonata grandis</i> Smith.....	—	×	—	—
<i>Trichotropis borealis</i> Brod. and Sowb.....	×	×	×	—
<i>Trichotropis tenuis</i> Smith.....	—	×	—	—
<i>Boreotrophon craticulatus</i> (Fabricius).....	×	—	—	×
<i>Boreotrophon clathratus</i> (Linné).....	—	—	×	×
<i>Buccinum belcheri</i> Reeve.....	×	×	—	—
<i>Buccinum cyaneum</i> Bruguière.....	×	×	—	×
<i>Buccinum cyaneum perdix</i> (Beck).....	×	—	—	—
<i>Buccinum ekblawi</i> Baker.....	×	—	—	—
<i>Buccinum hydrophanum</i> Hancock.....	×	×	×	—
<i>Buccinum tenue</i> Gray.....	—	—	×	×
<i>Buccinum tanqueryi</i> Baker.....	×	—	—	—
<i>Buccinum tumidulum</i> G. O. Sars.....	×	—	—	—
<i>Buccinum undulatum</i> Möller.....	×	—	—	—
<i>Colus tortuosus</i> (?) Reeve.....	—	×	—	—
<i>Bela bicarinata violacea</i> Migh. and Adams..	—	×	—	—
<i>Bela tenuicostata</i> M. Sars.....	—	—	×	—
<i>Bela ezarata</i> (Möller).....	—	—	×	—
<i>Bela trevelyana</i> (Turton).....	—	—	×	—
TOTAL SPECIES.....	38	34	24	21

An analysis of this table shows that Stimpson's list gives 21 species; Feilden's list (fossils), 24 species; Smith's list, 34 species; and the Crocker Land Expedition, 38 species. Nineteen species are in the Smith list that are not included in the Crocker Land Expedition material, while twenty-two species are in the Crocker Land Expedition list that are not in Smith's list. Fifteen species are found in both lists. Eight species occur in Stimpson's list that are not in Baker's list, and thirteen of the species of Stimpson's list are not in the Smith list. The combined

lists total seventy-two species and varieties for northwest Greenland. The absence of the smaller species from the Crocker Land Expedition material is noteworthy.

Several catalogues of the fauna of Greenland, including the Mollusca, have been published, among which may be mentioned: Fabricius, 1800; Möller, 1842; Mörch, 1857 and 1877; and Posselt, 1898. The increase in knowledge of the Greenland molluscan fauna is well shown by comparing the faunal lists of these authors, each separated by about twenty years.

Fabricius, 1780.....	49 species
Möller, 1842.....	133 species
Posselt, 1898.....	249 species

An analysis of Posselt's catalogue shows the following interesting distribution, indicating that the west coast fauna greatly exceeds the east coast fauna in number of species:

Inhabiting both east and west coast.....	61 species
Inhabiting east coast only.....	5 species
Inhabiting west coast only.....	169 species

Many students of Arctic Mollusca have written on the fauna of Greenland and their papers are scattered through the proceedings and transactions of learned societies. Few of these, however, have studied collections from as far north as the region under discussion.

The chief interest in the collection made by the Crocker Land Expedition is the number of species found in high latitudes and the extension of the northward range of several of the species. Thirty-two species and varieties were collected at Etah, in Foulke Fjord, which is about double the number obtained at any one point by the Nares Expedition, this party securing sixteen species from Discovery Bay, and eleven species from Franklin Pierce Bay. In Table II, the species and varieties collected by the Crocker Land party are listed from the different localities. It will be observed that eight species are recorded from 175 to 450 miles north of their previously reported northern limit (*vide* Posselt), while two species are recorded from the west coast of Greenland for the first time.

TABLE II.—DISTRIBUTION OF MOLLUSCA OF THE CROCKER LAND EXPEDITION¹

	ETAH	UMANAK	FOSHEIM PEN.	CANON FJORD	UFERNIVIK	M. NORTH OF PREVIOUS RECORD
<i>Tonicella marmorea</i> (Fabricius).....	x	—	—	—	—	—
<i>Leda pernula</i> (Müller).....	x	—	—	—	—	—
<i>Pecten islandicus</i> Müller.....	o	—	o	—	—	175
<i>Mytilus edulis</i> Linné.....	—	—	—	—	x	—
<i>Musculus substriatus</i> (Gray).....	x	—	—	—	—	175
<i>Musculus laevigatus</i> (Gray).....	—	o	—	—	—	—
<i>Crenella faba</i> (Müller).....	—	x	—	—	—	350
<i>Astarte crenata</i> (Gray).....	x	x	—	—	—	175
<i>Astarte crenata inflata</i> Hägg.....	x	—	—	—	—	1R
<i>Astarte arctica</i> (Gray).....	o	—	—	—	—	—
<i>Astarte borealis</i> (Schumacher).....	o	o	o	—	—	—
<i>Astarte borealis sericea</i> Posselt.....	—	o	—	—	—	—
<i>Astarte fabula</i> Reeve.....	x	—	—	o	—	—
<i>Serripes groenlandicus</i> (Gmelin).....	o	o	—	—	—	200
<i>Macoma calcarea</i> (Gmelin).....	x	—	—	—	—	—
<i>Mya truncata</i> Linné.....	x	x	—	—	—	—
<i>Mya truncata uddevallensis</i> Forbes.....	x	—	—	—	—	—
<i>Saxicava arctica</i> (Linné).....	x	x	o	—	x	—
<i>Tectura rubella</i> (Fabricius).....	x	—	—	—	—	450
<i>Lepeta cæca</i> (Müller).....	x	—	—	—	—	—
<i>Margarites helicina</i> (Phipps).....	x	x	—	—	—	—
<i>Margarites vahlæi</i> (Müller).....	x	—	—	—	—	450
<i>Margarites umbilicalis</i> Brod. and Sowb.....	x	—	—	—	—	—
<i>Margarites umbilicalis spiralis</i> Baker.....	o	—	—	—	—	n.v.
<i>Margarites cinerea</i> (Couthouy).....	x	—	—	—	—	450
<i>Solariella laevis</i> Friele.....	x	—	—	—	—	1R
<i>Trichotropis borealis</i> Brod. and Sowb.....	o	—	—	—	—	—
<i>Boreotrophon craticulatus</i> (Fabricius).....	o	—	—	—	—	—
<i>Buccinum undulatum</i> Möller.....	—	x	—	—	—	—
<i>Buccinum belcheri</i> Reeve.....	o	—	—	—	—	—
<i>Buccinum cyaneum</i> Bruguière.....	o	—	—	—	—	—
<i>Buccinum cyaneum perditæ</i> (Beck).....	—	o	—	—	—	—
<i>Buccinum tanquaryi</i> Baker.....	o	o	—	—	—	n.s.
<i>Buccinum ekblawi</i> Baker.....	o	—	—	—	—	n.s.
<i>Buccinum hydrophanum</i> Hancock.....	x	—	—	—	—	—
<i>Buccinum tumidulum</i> G. O. Sars.....	x	—	—	—	—	—
<i>Limacina helicina</i> (Phipps).....	x	—	—	—	—	—
<i>Clio limacina</i> (Phipps).....	x	—	—	—	—	—
TOTAL SPECIES.....	32	13	3	1	2	—

¹x, living specimens found; o, only dead shells found; 1R, first record from west coast of Greenland; n.s., new species; n.v., new variety.

FOSSIL MOLLUSCA FROM GREENLAND AND GRINNELL LAND

Fossil mollusks have long been known from southern Greenland but it was not until 1875-1876 that they were found to occur in abundance in the northernmost parts of Greenland and Grinnell Land. The Nares Expedition discovered many deposits of fossil shells, indicating the position of ancient beaches when the land was much lower than at the present time. Captain H. W. Feilden, naturalist to the Nares Arctic Expedition, made special effort to collect these fossils and secured twenty-four species from twenty-seven different localities, ranging from 10 to 800 feet above present sea-level (Jeffreys, 1877; Feilden, 1877).

For comparison with the recent shells collected by the British expedition (Smith, 1877) and also with those obtained by the Crocker Land party, the species found fossil in northern Greenland and Grinnell Land are listed in Table III, the modern names being used.

TABLE III.—FOSSIL AND RECENT MOLLUSCA FROM GREENLAND

FOUND FOSSIL BY NARES EXPEDITION	RECENT SPECIMENS FOUND BY	
	NARES EXPED.	CROCKER LAND EXPED.
<i>Leda pernula falcata</i> Jeffreys.....	—	—
<i>Leda frigida</i> (Torrell).....	—	—
<i>Leda glacialis</i> (Gray).....	×	—
<i>Leda arctica</i> (Gray).....	—	—
<i>Pecten grænlandicus</i> Sowerby.....	×	×
<i>Neera suborta</i> G. O. Sars.....	—	—
<i>Thracia obliqua</i> Jeffreys.....	—	—
<i>Astarte borealis</i> (Schumacher).....	×	×
<i>Astarte fabula</i> Reeve.....	×	×
<i>Axinus gouldii</i> Philippi.....	×	—
<i>Cardium islandicum</i> Linné.....	×	—
<i>Macoma calcarea</i> (Gmelin).....	×	×
<i>Mya truncata uddevallensis</i> Forbes.....	×	×
<i>Saxicava arctica</i> (Linné).....	×	×
<i>Siphonodentalium vitreum</i> G. O. Sars.....	—	—
<i>Margarites umbilicalis</i> Brod. and Sowb.....	×	×
<i>Trichotropis borealis</i> Brod. and Sowb.....	×	×
<i>Boreotrophon clathratus</i> (Linné).....	—	—
<i>Buccinum tenue</i> Gray.....	—	—
<i>Buccinum hydrophanum</i> Hancock.....	×	×
<i>Bela tenuicostata</i> M. Sars.....	—	—
<i>Bela exarata</i> (Möller).....	—	—
<i>Bela trevelyana</i> (Turton).....	—	—
<i>Cylichna alba</i> (Brown).....	×	—
TOTALS.....	13	9

It will be seen from Table III that thirteen of the twenty-four fossil species were obtained in recent state by the British expedition and nine species by the American expedition. Eleven species found fossil have not been collected in recent material from this region. These are noted in the table. In addition to the fossil mollusks obtained by the British expedition, several species of mammals and other vertebrates were collected in Kane Valley. These included reindeer, musk-ox, seal, and *Myodus torquatus*.

The Crocker Land Expedition, while exploring part of Ellesmere Land, discovered deposits of fossil marine shells on Fosheim Peninsula west and somewhat south of the deposits observed by Feilden, and at about 80° North latitude, the Feilden collections made being at latitude 82° 32' N. (north of Dumb-bell Harbor, near Cape Joseph Henry). The locality at which Mr. Ekblaw collected the marine shells is about 200–250 miles west of the localities visited by the British expedition and is believed to be the most westerly locality from which fossils have been listed.

Four species are in the collection of the Crocker Land Expedition. They were found in beach-ridges on Fosheim Peninsula and in an old beach-terrace 100 feet above sea-level, two miles inland, on the west side of Cañon Fjord, about three miles from the head of the fjord. These species are, *Pecten islandicus*, *Astarte borealis*, *Astarte fabula*, and *Saxicava arctica*. It will be noted that *Pecten islandicus* is not recorded by Feilden. The other three species are in Feilden's list.

In connection with these fossil shells and raised beaches the observations of Feilden (1877, pp. 484, 485), made over forty years ago, are of interest.

Numerous deposits of sand, mud, and gravel occupying the interior valleys, and the bottoms and margins of the fresh-water lakes dispersed over the land. These valleys must recently have been fiords, bays, or arms of the sea; the deposits now resting on their flanks and in the hollows, sometimes attaining a thickness of 200 to 300 feet, were formed by the summer torrents charged with sediment.

Oscillations of level in these regions since the close of the Tertiary epoch must have occurred on a considerable scale; for I detected Post-tertiary beds resting on undoubted Miocene strata, and extending to an elevation of not less than 1000 feet above their level. The obvious conclusion is, that since the period when a flora analogous in some respects to that now existing in Mexico flourished within 500 miles of the northern axis of our planet, there has been a subsidence of over 1000 feet, and a subsequent upheaval to a similar altitude.

The old beaches from which both Feilden and Ekblaw collected molluscan fossils are related to the Pleistocene or Glacial Period, and the fossils are possibly contemporaneous with the deposits at Montreal and

other parts of Canada, which were laid down during the latter part of the Pleistocene. It is also possible that they may be much older. The differences in the altitude of many of the deposits studied by Feilden suggest changes of climate such as recorded by Jensen at Orpigsint and other places on the Greenland coast (1909, p. 299).

DESCRIPTION OF SPECIES

AMPHINEURA

POLYPLACOPHORA

SCALIDÆ

Toxostoma (Fabricius)

- Chiton marmoreus* FABRICIUS, *Grænlandica*, p. 420.
Chiton ruber MÖLLER, 1825, *Nat. Hist. Græn.*, p. 89.
Boreochiton marmoreus G. O. SARS, 1878, *Moll. Reg. Arct. Norv.*, p. 116, Tab. VIII, fig. 3.
Tonicella marmorea PILSBRY, 1892, *Manual Conch.*, (1) XIV, p. 41, Pl. x, figs. 8-15.
Chiton (Boreochiton) marmoreus POSSELT, *Conspectus Faunæ Græn.*, p. III, 1898.

Distribution.—West Greenland, Nanortalik to Franklin Pierce Bay, Grinnell Land, 5-100 fathoms; east Greenland, north to latitude 65° 40' N., 25-40 fathoms. Crocker Land Expedition.—Etah, six specimens.

Of the six species of *Chiton* recorded from Greenland, *marmoreus* was the only one obtained by the expedition. It may be known by its red color ornamented with buff streaks, and by its leathery nude girdle. It is apparently the only species of Polyplacophora that extends its range to latitude 80° N., and is a circumboreal species, being found in both the Atlantic and Pacific oceans. It is reported by Smith from Franklin Pierce Bay, Grinnell Land. This *Chiton* is frequently found on the gills and other parts of the mouth of a shark which is abundant in Arctic waters and is much sought after by the Greenland Esquimo.

PELECYPODA

PRIONODESMACEA

Ledidæ

Leda pernula (Müller)

- Arca pernula* MÜLLER, 1779, *Beschäft. Berliner Gesell. naturf. Freunde*, IV, p. 57.
Leda pernula G. O. SARS, 1878, *Moll. Reg. Arct. Norv.*, p. 35, Tab. v, fig. 1a-d.
Leda prenula POSSELT, 1898, *Conspectus Faunæ Græn.*, p. 43.
Leda pernula VERRILL AND BUSH, 1898, *Proc. U. S. Nat. Mus.*, XX, p. 855, Pl. LXXXII, fig. 2.

Distribution.—West Greenland, Julianehaab to Discovery Bay, Grinnell Land, 5–300 fathoms; east Greenland, north to latitude 65° 40' N., 3–110 fathoms

Crocker Land Expedition.—Etah, head of Foulke Fjord, 2–10 fathoms, September 7, 1914.

But one specimen of this species was obtained by the expedition. It has the following measurements: length, 17; height, 10; breadth, 5.5 mm. The surface is ornamented by rather coarse and heavy concentric striations and the umbones are much eroded. In east Greenland it occurs abundantly in 3–50 fathoms on a clay bottom with stones. Smith reports *pernula* from Discovery Bay, Grinnell Land, in latitude 81° 41' N., and Jeffreys lists it (as variety *falcata* Jeff.) from Floeberg Beach, latitude 82° 27' N., in fossil deposits 200 feet above sea-level.

Pectinidæ

***Pecten (Chlamys) islandicus* Müller**

Pecten islandicus MÜLLER, 1776, Zool. Danicæ Prodr., p. 248.

Pecten islandicus FABRICIUS, 1780, Fauna Græn., p. 415.

Pecten islandicus MÖLLER, 1842, Index Moll. Græn., p. 89.

Pecten islandicus GOULD, 1870, Invert. Mass., p. 198, fig. 495.

Pecten islandicus G. O. SARS, 1878, Moll. Reg. Arct. Norv., p. 16, Tab. II, fig. 2.

Pecten islandicus POSSELT, 1898, Conspectus Faunæ Græn., p. 14.

Distribution.—West Greenland, Julianehaab to Etah, 5–200 fathoms. Does not occur on the east coast of Greenland except as a fossil.

Crocker Land Expedition.—Etah, Peeawahto Point, June 29, 1915, one perfect specimen, one beach-worn ventral valve; head of Foulke Fjord, 2–10 fathoms, one broken dorsal valve, September 7, 1914. Camp Ettookashoo, Fosheim Peninsula, April 22, 1915, fragments, collected by W. E. Ekblaw.

This large *Pecten* is a common mollusk on the west coast of Greenland. Smith lists *Pecten (Ammusium) grænlandicus* Sowerby from Discovery Bay, Grinnell Land, latitude 81° 41' N. but does not mention *islandicus*. Jeffreys also records *grænlandicus* as a fossil but does not list *islandicus*. It is possible that this species does not extend its range north of Etah. Mr. Ekblaw collected fragments of this *Pecten* on clay beach-ridges on Fosheim Peninsula in latitude 81° 30' N. Posselt gives the northern range as northwest of Cape York, or 175 miles south of the Etah locality.

Mytilidæ

***Mytilus edulis* Linné**

Mytilus edulis LINNÉ, 1758, Syst. Nat., Ed. X, I, p. 705.

Mytilus edulis FABRICIUS, 1780, Fauna Græn., p. 417.

Mytilus edulis MÖLLER, 1842, Index Moll. Græn., p. 92.

Mytilus edulis GOULD, 1870, Invert. Mass., p. 183, fig. 483.

Mytilus edulis POSSELT, 1898, Conspectus Faunæ Græn., p. 18.

Distribution.—West Greenland, Julianehaab to Upernivik, shore to 20 fathoms; east Greenland, north to latitude 75° 37'.

Crocker Land Expedition.—Søndre Upernivik, Danish Greenland, on shingly beach, June 1917.

Of this species Mr. Ekblaw says: "they live in shallow water along the shore among rocks, where they virtually cover the sea-bottom for long stretches." This species evidently does not extend as far north as the other species of pelecypods, Umanak being its northern limit. This is about 125 miles south of the Etah locality from which most of the material came.

***Musculus substriatus* (Gray)**

Modiola lævigata var. *B. substriata* GRAY, 1824, Suppl. to Appendix to Parry's Voyage, 1819–1820, p. 129, fig. 83.

Modiolaria discors GOULD, 1870, Invert. Mass., p. 192, fig. 489 (*non* Linné).

Modiolaria substriata POSSELT, 1898, Conspectus Faunæ Græn., p. 26.

Distribution.—West Greenland, Nanortalik to Etah, 5–100 fathoms; east Greenland, Hekla Havn, Gaaseland.

Crocker Land Expedition.—Etah, Foulke Fjord, 40 fathoms, August 21, 1914, four specimens; dredged in July or early August, 1914, twenty specimens; head of Foulke Fjord, 2–10 fathoms, September 7, 1914, three empty valves; Etah, on beach, eight specimens; Peccawahto Point, near Etah, two specimens; North Star Bay, Umanak, on beach, one living specimen, on *Laminaria*, two specimens, July 13, 1914.

This mollusk is a common species in west Greenland. Jensen (1909, p. 327) states that *substriatus* is rarely found in east Greenland, the common *Musculus* being *lævigatus* Gray. This condition is apparently reversed in west Greenland, *substriatus* being the commoner species. Smith lists *lævigata* from Franklin Pierce Bay, Grinnell Land (latitude 79° 25' N.) but does not mention *substriata*. *Musculus* has not been detected among the fossils from the deposits of Grinnell Land. Posselt gives the northern range as northwest of Cape York, which is 175 miles south of the Etah locality.

The Greenland specimens of this species are somewhat variable. The periostracum of the shell varies from bright lemon-yellow or greenish yellow in the young and immature individuals to black or dark chestnut in the adult specimens. In some specimens there is a central vertical zone of dark brown extending from the umbones to the ventral margin. The dredged specimens are mostly small, ranging from 3.50 to 23 mm. in length.

The two species called *substriatus* and *lævigatus* are closely related. Young specimens of *substriatus* 8 mm. long, dredged in Foulke Fjord, have the posterior slope strongly striated and quite fully meet the requirements of sculpture for *lævigatus*. On specimens 13 mm. long the sulcations have become weaker and are lacking on the ventral portion of the shell, and on specimens 17 mm. long the striations have entirely disappeared from the ventral third of the shell which is marked only by very fine radial impressed lines. In shells 24 mm. long the striations are reduced to a few radial riblets near the umbones and these persist in the largest specimens examined, 40 mm. long. The riblets on the anterior part of the shell are always sharply defined in both adult and young individuals. A shell 1½ mm. long, from Umanak, has both umbonal slopes strongly striated. The presence of these young shells with strongly striated posterior margin leads one to question the distinctness of the two species, the *lævigatus* condition changing to the *substriatus* condition as the mussel increases in age. Adult shells, however, are quite easily separated, the absence of posterior striation in *substriatus* and its presence in *lævigatus* being clearly indicated.

***Musculus lævigatus* (Gray)**

Mytilus descors FABRICIUS, 1790, Fauna Grœn., p. 418 (non Linné).

Modiola lævigata GRAY, 1824, Parry's First Voyage, Suppl. to Appendix, p. 24.

Modiolaria lævigata G. O. SARS, 1878, Moll. Reg. Arct. Norv., p. 29, Tab. III, fig. 3a-b.

Modiolaria lævigata POSSELT, 1898, Conspectus Faunæ Grœn., p. 25.

Distribution.—West Greenland, Nanortalik to Franklin Pierce Bay, Grinnell Land, 5–300 fathoms; east Greenland, Angmagsalik to Shannon Fjord, 3–30 fathoms.

Crocker Land Expedition.—North Star Bay, three valves in beach débris.

Of the 30 or more specimens of *Musculus* collected by the expedition, only three valves represent the present species, which appears to be rare in the localities visited. It may be known from *substriatus* by the striate posterior margin of the shell which is almost smooth in *substriatus*. In east Greenland, *lævigatus* occurs on a stony bottom in water 1–60 fathoms deep. It is recorded by Smith from Franklin Pierce Bay, Grinnell Land, in 15 fathoms.

***Crenella faba* (Müller)**

Mytilus faba MÜLLER, 1776, Prod. Zool. Dan., p. 250.

Mytilus faba FABRICIUS, 1780, Fauna Grœn., p. 419.

Modiola faba MÖLLER, 1842, Index Moll. Grœn., p. 92.

Modiolaria faba POSSELT, 1898, Conspectus Faunæ Græn., p. 22.

Crenella faba DALL, 1902, Proc. U. S. Nat. Mus., XXIV, p. 508, Pl. xxxi, fig. 12.

Distribution.—West Greenland, Ivigtut to Umanak, 5–250 fathoms.

Crocker Land Expedition.—Umanak, three specimens.

The specimens obtained by the expedition are smaller than that figured by Dall (*op. cit.*, 18 mm. long), measuring but 8.5 mm. They are apparently typical *faba*, however, being of a livid purple-brown color externally, with lavender interior. This species is closely related to *Crenella pectinula* Gould, a common species of the North Atlantic coast of North America. As it is not listed by Smith from the Grinnell Land region it probably does not extend its range much farther north of the Umanak region. Posselt gives the northern range as Upernivik, which is about 350 miles south of the Umanak locality.

Astartidæ

Upwards of twelve species of this family have been recorded from Greenland waters (Dall, 1903) four of which are represented in the material brought back by the Crocker Land Expedition.

Astarte crenata (Gray)

Plate XXV, Figures 1, 2

Nicania crenata GRAY, 1824, Parry's First Voyage, Suppl. to Appendix, p. 242.

Astarte crebristriata G. O. SARR, 1878, Moll. Reg. Arct. Norv., p. 54, Tab. v, fig. 7a-b.

Astarte crenata POSSELT, 1898, Conspectus Faunæ Græn., p. 64.

Astarte crenata DALL, 1903, Proc. U. S. Nat. Mus., XXVI, p. 939.

Distribution.—West Greenland, Julianehaab to Etah, Foulke Fjord, 5–410 fathoms; east Greenland, north to Shannon Fjord, 30–160 fathoms.

Crocker Land Expedition.—Etah, Foulke Fjord, 40 fathoms. August 21, 1914, eight specimens; Umanak Fjord, July 13, 1914, fifteen specimens on *Laminaria*; North Star Bay, eight specimens.

Crenata is said to be a rare species and appears in but few lists of Greenland mollusks. It is not mentioned by Smith among the shells obtained in Grinnell Land nor by Jeffreys among the fossils of the same region. It would appear, therefore, that the specimens from Etah mark the most northern locality thus far recorded for this species. Posselt gives Cape York as the northern range, 175 miles south of the Etah locality. The Crocker specimens are somewhat variable in form and sculpture. In some individuals the anterior end is greatly produced and the shell is quadrate in form. Other individuals are ovate with the umbones nearer the anterior end. The concentric ribs vary in number and coarseness, and the shell is thinner than most of the species of the

genus. The color of the Crocker Land specimens is light brown in living shells and straw-colored in beach shells. Several characteristic measurements are given below.

Length, 19.5	Height, 14.5	Breadth, 9	mm.	Foulke Fjord
20.5	14.5	9.5	mm.	Foulke Fjord
18	13	8	mm.	Foulke Fjord
22	18	11	mm.	Amanak Fjord
19.5	16	9	mm.	Amanak Fjord

Specimens were submitted to Dr. W. H. Dall who stated that they were quite typical *crenata*.

***Astarte crenata inflata* Hägg**

Plate XXV, Figure 3

Astarte crenata var. *inflata* Hägg, 1904, Archiv for Zoologi, II, No. 2, p. 37, Taf. I, figs. 4-6.

A single specimen from Foulke Fjord, dredged in August 1914, is apparently referable to this variety. It is ventricose, with a short anterior end and truncate posterior end, the color being yellowish brown. The specimen has the following measurements: length, 18; height, 15; breadth, 9 mm.

***Astarte arctica* (Gray)**

Plate XXV, Figure 10

Crassina arcilca GRAY, 1824, Parry's First Voyage, Suppl. to Appendix, p. 242.

Astarte arctica MÖLLER, 1842, Index Moll. Grœn., p. 92.

Astarte arctica DALL, 1903, Proc. U. S. Nat. Mus., XXVI, p. 940.

Distribution.—Vadso, Norway; the Arctic Atlantic, Davis Strait, and Greenland, in 15 to 60 fathoms. Also near Bering Sea (Dall).

Crocker Land Expedition.—Etah, from shore débris, four specimens,

Arctica is considered a form of *borealis* by most students, including the Arctic writers, Jensen, Posselt, Smith, and Jeffreys. It is quite distinct, however, being entirely without concentric ribbing on the beaks, a feature that is quite conspicuous in *borealis*. Only four specimens were collected by the expedition and these are large and apparently typical. The epidermis is black, the shell very heavy and the valves thick. The umbones are all eroded and in one specimen half the surface of both valves has been deeply eroded. The largest specimen measures as follows: length, 45; height, 38; breadth, 20 mm.

Arctica has not been reported from east Greenland.

***Astarte borealis* (Schumacher)**

Plate XXV, Figures 5 to 7

Tridonta borealis SCHUMACHER, 1817, Essai Nouv. Syst. Hab. Test., p. 147, Pl. xvii, fig. 1.*Tridonta borealis* G. O. SARS, 1878, Moll. Reg. Arct. Norv., p. 50, Tab. v, fig. 8a-b (part).*Astarte borealis* POSSELT, 1898, Conspectus Faunæ Græn., p. 61.*Astarte borealis* DALL, 1903, Proc. U. S. Nat. Mus., XXVI, p. 941.

Distribution.—West Greenland, Julianehaab to Discovery Bay, 5–43 fathoms; east Greenland, north to Shannon Fjord, 8–40 fathoms.

Crocker Land Expedition.—Etah (six specimens) and North Star Bay (twenty-three specimens) in shore débris; Camp Etookashoo, Fosheim Peninsula, in clay beach-ridges; Cañon Fjord, Fosheim Peninsula, about three miles from head of fjord (about fifty fossil specimens from Fosheim Peninsula).

The specimens of *borealis* vary considerably in form and in coloration. All agree, however, in having strongly ribbed beaks, the greater portion of the ventral and middle portion of the valve showing only fine growth-lines. The extent of ribbing varies considerably, in some individuals being confined to the region of the beaks while in others it extends half way to the ventral margin. In young specimens the whole valve may be sulcate. In outline the shells vary from almost circular, with the posterior end truncated, to elliptical, with an elongated posterior end. Several characteristic measurements are indicated below.

Length, 36	Height, 28	Breadth, 12 mm.
31	24	10 mm.
29.5	24	9.5 mm.
37	32	16 mm.
27	24	6.5 mm.

The color ranges, in the expedition specimens, from deep chestnut to black. The fossil specimens are yellowish white. Specimens were submitted to Dr. W. H. Dall, who identified them as typical *borealis*.

Borealis is recorded from Dumb-bell Harbor and Discovery Bay, Grinnell Land, by Smith (as *Astarte semisulcata*), dredged in 5 fathoms. It is a common Arctic species, circumboreal in distribution, extending its range on the Atlantic coast as far south as Cape Cod Bay. On the east coast of Greenland it has been dredged in 1–158 fathoms on clay and mud bottom with stones.

Fossil shells referable to this species occur plentifully near Camp Etookashoo, on Fosheim Peninsula in clay beach-ridges, and in an old beach-terrace 100 feet above the sea, two miles inland, on the west side

of Cañon Fjord, about three miles from the head of the fjord. The fossils are very large, the umbones eroded in the Cañon Fjord specimens, and with the concentric ridging absent from all parts of the shell except the umbones, in most specimens. There is also some variation in the elevation of the umbones. Two characteristic measurements are:

Length, 43	Height, 35 mm.
45	34 mm.

Astarte borealis is recorded by Jeffreys and Feilden as a fossil from many places in Grinnell Land and the northwestern part of Greenland, at heights from 100 to 400 feet above sea-level.

***Astarte borealis sericea* Posselt**

Plate XXV, Figures 8, 9

Astarte borealis (Chemnitz) var. *sericea* POSSELT, 1895, Meddel. om Grønland, XIX, p. 71, Tab. I, figs. 8-12.

Astarte borealis var. *sericea* POSSELT, 1898, Conspectus Faunæ Grœn., p. 63.

Three specimens from North Star Bay appear to belong to the variety *sericea* of Posselt, being much elongated with dark brown or black epidermis. *Sericea* was described from specimens collected on the east coast of Greenland, at Hekla Havn. Jensen (1909, p. 335) states that all of the east Greenland specimens which he had examined were "more or less compressed and as a rule extremely lengthened." The only difference observed in the west Greenland specimens is that the shells of the form called *sericea* are more elongated and hence not as high compared with the length as are the typical specimens of *borealis*. There is quite a difference from this standpoint between the three shells selected as *sericea* and typical *borealis*, but whether this difference would prove constant in a large series of specimens is perhaps to be questioned. Measurements of the three specimens of *sericea* are given below. These should be compared with measurements of typical *borealis* which appear on a previous page.

Length, 36	Height, 30	Breadth, 13 mm.
37	26	14 mm.
32	22	13 mm.

***Astarte fabula* Reeve**

Plate XXV, Figure 4

Astarte fabula DALL, 1903, Proc. U. S. Nat. Mus., XXVI, p. 942.

Distribution.—FRANZ JOSEPH LAND to Greenland and adjacent Arctic waters in 12 to 90 fathoms. Also in the Polar Sea near Bering Strait (Dall).

Crocker Land Expedition.—Foulke Fjord, dredged in 40 fathoms, August 21, 1914, one specimen; Cañon Fjord, two miles inland on west side of fjord about three miles from head, on old sea-terrace, 100 feet above sea-level, April 28, 1915, one valve.

The single living specimen was submitted to Dr. Dall who reported it to be an elongated mutation of *Astarte fabula*. This specimen has about twenty-four distinct sulcations in the umbonal region, the rest of the shell being simply marked by growth-lines. A single valve was found among fossils from Cañon Fjord. The two specimens referred to this species measure as follows:

LIVING.	Length, 25.5	Height, 19.5	Breadth, 9 mm.
FOSSIL.	17	13 mm.	

Astarte fabula is not mentioned by Posselt, possibly being included in *banksi* which is listed. It is listed by Smith from Dumb-bell Harbor and Discovery Bay and by Jeffreys and Feilden as a fossil from several places in Grinnell Land and Ellesmere Land, at heights of 50-200 feet above sea-level.

Cardiidae

Serripes grænlandicus (Gmelin)

Venus islandica FABRICIUS, 1780, Fauna Grœn., p. 411 (*non* Linné).

Cardium grænlandicum GMELIN, 1790, Syst. Nat., I, part 6, p. 3252.

Cardium grænlandicum MÖLLER, 1842, Index Moll. Grœn., p. 93.

Aphrodite grænlandica G. O. SARS, 1878, Moll. Reg. Arct. Norv., p. 49, Tab. v, fig. 3 a-b.

Cardium (Serripes) grænlandicum POSSELT, 1898, Conspectus Faunæ Grœn., p. 55.

Serripes grænlandicus DALL, 1900, Proc. U. S. Nat. Mus., XXIII, p. 388.

Distribution.—West Greenland, Frederiksdal to Etah, 5-170 fathoms; east Greenland, Hekla Havn.

Crocker Land Expedition.—Etah, on beach, twelve valves. Head of Foulke Fjord, Etah, 2-10 fathoms, Sept. 7, 1914, one specimen. North Star Bay, in kelp on gravel beach, about thirty-six valves. Peccawaho Point, Foulke Fjord, fragments of valves.

This is apparently a common species in west Greenland. The specimens are of large size, reaching a maximum length of 69 mm. Jensen (1909, p. 353) gives the length of large specimens from east Greenland as from 53 to 55 mm. In this territory it occurs commonly from one to ten fathoms on a clay and sandy clay bottom among laminarians. This species is not listed by Smith among the material collected in Grinnell Land and it is also absent from the list of fossils

by Jeffreys and Feilden from the same territory. *Cardium islandicus* is listed by all of these authors but this is quite another species. It seems evident that the Foulke Fjord record of *grønlandicus* is the farthest north of any yet reported. It is about 200 miles north of Posselt's northern range, Melville Bay.

Tellinidæ

Macoma calcarea (Gmelin)

Tellina calcarea GMELIN, 1790, Syst. Nat., I, part 6, p. 3236.

Tellina calcarea MÖLLER, 1842, Index Moll. Græn., p. 93.

Macoma proxima GOULD, 1870, Invert. Mass., p. 95, fig. 401.

Macoma calcarea G. O. SARS, 1878, Moll. Reg. Arct. Norv., p. 76, Tab. VI, fig. 2 a-b.

Macoma calcaria POSSELT, 1898, Conspectus Faunæ Græn., p. 85.

Distribution.—West Greenland, Julianehaab to Etah, 5–380 fathoms; east Greenland, north to latitude 65° 40', 25–40 fathoms.

Crocker Land Expedition.—Foulke Fjord, 40 fathoms, Aug. 21, 1914, one specimen; Etah, five specimens.

This *Macoma* is apparently not uncommon in the region about Etah. The specimens are quite typical and do not differ from individuals living on the New England coast. It is recorded by Smith, as *Tellina tenera* Leach, from Discovery Bay, in 5 fathoms, and by Feilden from fossil deposits in Greenland and Ellesmere Land, 200 and 300 feet above sea-level. Posselt gives the northern range as Melville Bay, about 200 miles south of Etah.

Myacidæ

Mya truncata Linné

Mya truncata LINNÉ, 1758, Syst. Nat., Ed. 10, I, p. 670.

Mya truncata FABRICIUS, 1780, Fauna Græn., p. 404.

Mya truncata MÖLLER, 1842, Index Moll. Græn., p. 94.

Mya truncata SARS, 1878, Moll. Reg. Arct. Norv., p. 92.

Mya truncata POSSELT, 1898, Conspectus Faunæ Græn., p. 99.

Distribution.—West Greenland, Julianehaab to Dobbin Bay and Discovery Bay, Grinnell Land, 5–380 fathoms; east Greenland, north to Sabine Fjord, 25–40 fathoms.

Crocker Land Expedition.—Etah, on beach at low tide, Aug. 21, 1914, twelve specimens, young to adult; head of Foulke Fjord, 2–10 fathoms, three specimens; Etah, on beach, six valves.

Mya truncata is a common mollusk in west Greenland. It is more abundant in shallow water, specimens from deeper water usually being young and immature. The specimens obtained by the expedition are

not as a rule as large as individuals from the New England coast, the largest valve from Etah measuring 65 millimeters in length. *Mya truncata* is listed by Smith from Dobbin Bay and Discovery Bay, Grinnell Land, and the species probably extends as far north as mollusks can live on this Arctic coast. Jeffreys lists it among the fossils from deposits in Grinnell Land and adjacent territory. This clam is largely used as food by the walrus and other Arctic animals. The same is true of *Saxicava arctica*.

***Mya truncata uddevallensis* Forbes**

Mya uddevallensis Forbes, HANCOCK, 1846, Ann. Mag. Nat. Hist., XVIII, p. 337.

Mya truncata var. *uddevallensis* JENSEN, 1909, Meddel. om Græn., XXIX p. 309.

Distribution.—Probably the same as *truncata* in northern latitudes.

Crocker Land Expedition.—Etah, head of Foulke Fjord, 2-10 fathoms, three specimens; Peeawahto Point, Foulke Fjord, ten specimens, June 29, 1915; Umanak, on *Laminaria*, two specimens, July 13, 1914.

The *Myas* of the expedition may be divided into two forms, one the typical *truncata*, or near it, and the other the variety *uddevallensis* Forbes, in which the shell is short and high and the truncation extends obliquely backward, differing in this respect from typical *truncata* in which the truncation is obliquely forward or is perfectly vertical. The young shells have the posterior end rounded and the beaks near the middle of the valve, resembling the young of *Mya arenaria*.

The variety *uddevallensis* includes about half the material collected by the expedition. Jensen (1909, p. 355) states that the variety preponderates in east Greenland. Jensen's largest specimen measured 53.5 mm. in length; the largest specimen in the Crocker Land material measures 54 mm. in length, showing that the variety reaches about the same size on both the east and west coasts. A large specimen from Etah measures 52 mm. long and 38 mm. high. A small individual from *Laminaria* measures 11 mm. in length. The variety is listed by Feilden from various places in fossil deposits from 40 to 800 feet above sea-level.

Saxicavidae

***Saxicava arctica* (Linné)**

Mya arctica LINNÉ, 1767, Syst. Nat., Ed. 12, p. 1113.

Mya arctica FABRICIUS, 1780, Fauna Græn., p. 407.

Saxicava arctica G. O. SARS, 1878, Moll. Reg. Arct. Norv., p. 95, Tab. xx, fig. 8 a-c.

Saxicava arctica POSSELT, 1898, Conspectus Faunæ Græn., p. 94.

Distribution.—West Greenland, Nanortalik to Dobbin Bay, Grinnell Land, 2-280 fathoms; east Greenland, north to Shannon Fjord, 30 fathoms.

Crocker Land Expedition.—Etah, from beach débris, thirty-four specimens; Foulke Fjord, head, 2–10 fathoms, Sept. 7, 1914, two specimens; Foulke Fjord, 40 fathoms, August 21, 1914, eight specimens; Peeawahto Point, Etah, beach débris, one specimen; North Star Bay, one specimens; Amanak, on *Laminaria*, July 13, 1914, one specimen; Sondre Upervnik, in coral-like marine plant, brought up on shark line, May 1917, two specimens.

All of the Crocker Land material appears to be of the pholadis-form described by Jensen (1909, p. 358). The shells vary in thickness and in the rib-like character of the lines of growth which are very heavy on the young and immature shells but disappear on the very old shells, leaving only the heavy lines of growth. The species attains a large size, a single individual from Peeawahto Point measuring 53 mm. in length. In old specimens the posterior ridge becomes less conspicuous and in some specimens entirely disappears. A single specimen in the collection is quite arcuate on the ventral margin and is higher in proportion to the length than the majority of the specimens, due possibly to a cramped position among the stones along the shore.

Saxicava arctica is listed by Smith from Discovery Bay, Dobbin Bay, and Franklin Pierce Bay, in 5–30 fathoms. As a fossil it is listed by both Jeffreys and Feilden as abundant in various places in Grinnell Land and northwest Greenland, in beds from 40 to 400 feet above sea-level. Mr. Ekblaw discovered the species as a fossil in clay beach-ridges at Camp Ettookashoo, Fosheim Peninsula, April 22, 1915. The fossil shells are not as large as the recent specimens collected by the expedition.

GASTROPODA

ASPIDOBANCHIA

Acmaeidae

Tectura rubella (Fabricius)

Patella rubella FABRICIUS, 1780, Fauna Grœn., p. 386.

Patella rubella MÖLLER, 1842, Index Moll. Grœn., p. 89.

Tectura rubella G. O. SARS, 1878, Moll. Reg. Arct. Norv., p. 121, Tab. VIII, fig 5 a-b.

Acmaea rubella PILSBRY, 1891, Man. Conch., (1) XIII, p. 9, Pl. XLII, figs. 79, 80.

Tectura rubella POSSELT, 1898, Conspectus Faunæ Grœn., p. 115.

Distribution.—West Greenland, Julianehaab to Etah, 5–100 fathoms; east Greenland, Hekla Havn.

Crocker Land Expedition.—Foulke Fjord in 40 fathoms, August 21, 1914.

A single specimen of this little limpet was detected in a vial of specimens from Foulke Fjord. It is large for the species, measuring 5.5 mm. in length and 4.5 mm. in width. The species is not listed by Smith from Grinnell Land nor does it appear in Jeffrey's fossil list. Its previously reported northern limit appears to be Upernivik (Posselt) and the Etah record, about 450 miles farther north, seems to be its most northern recorded range.

Lepetidae

Lepeta cæca (Müller)

Patella cæca MÜLLER, 1776, Zool. Danicæ Prod., p. 237.

Lepeta cæca G. O. SARS, 1878, Moll. Reg. Arct. Norv., p. 123, Tab. xx, fig. 17 a-b.

Lepeta cæca PILSBRY, 1891, Man. Conch., (1) XIII, p. 68, Pl. xi, figs. 29-32.

Lepeta cæca POSSELT, 1898, Conspectus Faunæ Græn., p. 117.

Distribution.—West Greenland, Julianehaab to Richardson Bay, Grinnell Land, 2-300 fathoms; east Greenland, Hekla Havn to Walrus Fjord, 25-40 fathoms.

Crocker Land Expedition.—Etah, Foulke Fjord, 40 fathoms, August 21, 1914, seven specimens.

This handsome little shell was found associated with *Tectura rubella*, *Margarites umbilicalis*, and other mollusks, dredged at this depth. The specimens are not of maximum size (10 mm. long) but seem typical. Six living specimens were obtained and these are covered with beautifully beaded radiating ribs. The apex is eroded in all specimens. This species is listed by Smith from Franklin Pierce Bay, Richardson Bay, and Cape Fraser, in 15 to 70 fathoms. It is not recorded as a fossil by Jeffreys or Feilden.

Trochidae

Upwards of ten species of this family are recorded from Greenland waters, five of which are represented in the Crocker Land Expedition material. Nearly all of these are of the genus *Margarites*.

Margarites helicina (Phipps)

Turbo helycinus PHIPPS, 1774, Voyage toward the North Pole, p. 198.

Turbo helycinus FABRICIUS, 1780, Fauna Græn., p. 393.

Margarita helicina MÖLLER, 1842, Index Moll. Græn., p. 81.

Margarita helicina PILSBRY, 1889, Man. Conch., (1) XI, p. 285, Pl. LXIV, figs. 45-47; Pl. XXXIX, fig. 63.

Margarita helicina POSSELT, 1898, Conspectus Faunæ Græn., p. 122.

Distribution.—West Greenland, Julianehaab to Franklin Pierce Bay, Grinnell Land, 2-100 fathoms; east Greenland, Shannon Fjord, 4-22 fathoms.

Crocker Land Expedition.—Foulke Fjord, dredged in July or early August, 1914, one specimen; Umanak, on *Laminaria*, in lead in ice near shore, June 9, 1914, one hundred and eleven specimens.

This beautiful little pearly snail is apparently common in shallow water (2–20 fathoms) near shore, in Greenland. It is the most abundant species collected by the expedition. Its habitat at Umanak, on *Laminaria*, suggests this vegetation as its food-plant. The Umanak specimens are also peculiar in being heavily encrusted with a species of Bryozoa. *Helicina* is widely distributed in England, Scandinavia, Greenland, New England, Bering Sea, and south on the Pacific coast to Washington. Though given by Posselt as occurring as far north as Franklin Pierce Bay it is not mentioned by either Smith or Jeffreys among the shells of Grinnell Land. The finding of but a single shell near Etah by the Crocker Land Expedition would seem to indicate that it is rare as far north.

***Margarites vahlii* (Möller)**

Margarita vahlii MÖLLER, 1842, Index Moll. Grœn., p. 8.

Margarita vahlii PILSBRY, 1889, Man. Conch., (1) XI, p. 289, Pl. xxxix, figs. 58, 59.

Margarita vahlii POSSELT, 1898, Conspectus Faunæ Grœn., p. 124.

Distribution.—West Greenland, Godthaab to Etah, 2–300 fathoms.

Crocker Land Expedition.—Etah, Foulke Fjord, dredged in July or early August, 1914.

A single shell of this tiny *Margarites* was found with several other shells dredged in Foulke Fjord. It agrees in all respects with the description in the Manual of Conchology and with the figures on plate xxxix of that work, except that the spire is a trifle more depressed in the Crocker Land specimen. This specimen measures as follows: length, 2.75; diameter, 2.75 mm. *Vahlii* has apparently not been previously reported north of Upernivik, 450 miles south of the Etah locality. It is not listed by either Smith or Jeffreys among the mollusks of Grinnell Land and vicinity.

***Margarites umbilicalis* (Broderip and Sowerby)**

Margarita umbilicalis BRODERIP AND SOWERBY, 1829, Zool. Journ., IV, p. 371.

Margarita umbilicalis PILSBRY, 1889, Man. Conch., (1) XI, p. 288, Pl. xxxix, figs. 61, 62, 64; Pl. LXIV, figs. 39–41.

Margarita umbilicalis POSSELT, 1898, Conspectus Faunæ Grœn., p. 127.

Distribution.—West Greenland, Nanortalik to Floeberg Beach, Grinnell Land, 5–160 fathoms; east Greenland, north to Shannon Fjord and Germania Havn, 2–40 fathoms.

Crocker Land Expedition.—Etah, Foulke Fjord, dredged in July or early August, 1914, two specimens; head of Foulke Fjord 2–10 fathoms, Sept. 7, 1914, eight specimens; Foulke Fjord, 40 fathoms, August 21, 1914, two specimens; Etah, from beach débris, nine specimens; Peeawahto Point, Foulke Fjord, one specimen.

This is the largest species of the genus found in Greenland waters and is apparently a common mollusk in west Greenland and adjacent territory. It varies considerably in form and sculpture. In full-grown typical examples there are usually six whorls, the nuclear whorls are very finely striate, the striae increasing in strength to the third whorl where they may form raised ribs; with fourth whorl they grow fainter and disappear on the fifth and sixth whorls which are usually smooth. The height of the spire varies considerably in the Etah specimens. Some extreme measurements are given below:

Height, 19	Diameter, 22 mm.
17	21.5 mm.
17.5	20 mm.
16	19 mm.

Margarites umbilicalis is listed by Smith from Franklin Pierce Bay, in 15 fathoms, and by Jeffreys as a fossil from Shell Flats, 200 feet above sea-level, and Kane Valley, 40 feet above sea-level.

***Margarites umbilicalis spiralis*, new variety**

Crocker Land Expedition.—Etah, beach débris, two specimens; head of Foulke Fjord, 2–10 fathoms., Sept. 7, 1914, two specimens.

Among the specimens collected at Etah are several individuals in which the spiral sculpture is continued from the upper whorls to the aperture, producing wide, raised bands separated by narrow incised channels. A rather wide space within the umbilicus is without impressed lines.

Height, 15	Diameter, 18 mm.	Holotype A. M. N. H., No. 2511.
15	18.5 mm.	Paratype, N. H. Mus., Univ. Ill., No. Z10862.

The sculpturing of this variety is so striking and the absence of intermediate forms so marked that a name seems necessary for this shell. The Arctic shells from Greenland, of which about thirty specimens have been examined, are either lirate on the upper third and fourth whorls or lirate on all the whorls, intermediate forms being absent. The variety seems to be rare.

Margarites cinerea (Couthouy)

Trochus cinerarius FABRICIUS, 1780, Fauna Grœn., p. 391 (*non* Linné).

Turbo cinereus COUTHOUY, 1839, Bost. Journ. Nat. Hist., II, p. 99. Pl. III, fig. 9.

Margarita striata MÖLLER, 1842, Index Moll. Grœn., p. 81.

Margarita cinerea G. O. SARS, 1878, Moll. Reg. Arct. Norv., p. 134, Tab. IX, fig. 1 a-c.

Margarita cinerea PILSBRY, 1889, Man. Conch., (1) XI, p. 291, Pl. LXIV, figs 53, 54.

Margarita cinerea POSSELT, 1898, Conspectus Faunæ Grœn., p. 129.

Distribution.—West Greenland, Julianehaab to Etah, 5–200 fathoms; east Greenland, Hekla Havn.

Crocker Land Expedition.—Etah, Foulke Fjord, dredged Aug. 7, 1914, two specimens.

This *Margarites* is a variable species of wide distribution. Of the two specimens obtained by the Crocker Land party, one has five and the other six whorls. Both are strongly lirate, the basal portion of the last whorl near the umbilicus being less distinctly marked, however, than the rest of the shell. The nuclear whorls are smooth and hyaline. Judging by the small number of specimens collected this species must be a rare shell in this part of Greenland. The specimens measure as follows:

Height, 12	Diameter, 13.5 mm.
8	9 mm.

This species is not mentioned by either Smith or Jeffreys from Grinnell Land and no records have been seen north of Upernivik, 450 miles south, the northern limit given by Posselt. Etah, therefore, appears to be its northernmost recorded range.

Solariella lævis Friele

Solariella lævis FRIELE, 1886, Norwegian North-Atlantic Expedition, Moll., part 2, p. 30, Pl. XII, figs. 4-6.

Solariella obscura var. *lævis* PILSBRY, 1889, Man. Conch., (1) XI, p. 310, Pl. LXVI, figs. 94-96.

Distribution.—Arctic Ocean east of Greenland, 300–350 fathoms.

Crocker Land Expedition.—Etah, Foulke Fjord, dredged in 40 fathoms, August 1914, four specimens.

No record of this tiny species has been seen from west Greenland. There seems little question, however, that the specimens from Etah are the *lævis* described by Friele. The shells are of the same size, shape, and texture as those of Friele. The surface is brilliantly polished, pearly, and without a trace of spiral sculpture, even the base of the shell being without the faint angular margin below the periphery described by Friele. Two specimens measure as follows:

Height, 4.5	Diameter, 4.5 mm.
4	3.5 mm.

This appears to be the first record of this beautiful little shell from west Greenland as well as from shallow water.

Trichotropidæ

Trichotropis borealis Broderip and Sowerby

Trichotropis borealis BRODERIP AND SOWERBY, 1828, Zool. Journ., IV, p. 375.

Trichotropis atlantica Beck, MÖLLER, 1842, Index Moll. Græn., p. 12.

Trichotropis borealis GOULD, 1870, Invert. Mass., p. 390, fig. 651.

Trichotropis borealis G. O. SARS, 1878, Moll. Reg. Arct. Norv., p. 163.

Trichotropis borealis POSSELT, 1898, Conspectus Faunæ Græn., p. 168.

Distribution.—Julianehaab to Dumb-bell Harbor, Grinnell Land, 5–250 fathoms.

Crocker Land Expedition.—Etah, head of Foulke Fjord, 2–10 fathoms, Sept. 7, 1914, four specimens.

This variable species is apparently not common in the vicinity of Etah. The specimens collected, three of which were living, show some variation in ribbing, three specimens having small riblets between the primary riblets, especially between the suture and the upper carina on the body whorl. It is listed by Smith from Dumb-bell Harbor and Discovery Bay in five fathoms. Jeffreys lists it from Kane Valley mud beds, 40 feet above sea-level, the deposit being in latitude 82° 33' N.

Muricidæ

Boreotrophon craticulatus (Fabricius)

Tritonium craticulatum FABRICIUS, 1780, Fauna Græn., p. 401.

Trophon fabricii (Beck) MÖLLER, 1842, Index Moll. Græn., p. 87.

Trophon fabricii, POSSELT, 1898, Conspectus Faunæ Græn., p. 174.

Boreotrophon craticulatus DALL, 1902, Proc. U. S. Nat. Mus., XXIV, p. 538.

Distribution.—West Greenland, Julianehaab to Etah.

Crocker Land Expedition.—Etah, Foulke Fjord, dredged in early August 1914, one specimen.

Of the five species of *Boreotrophon* credited to Greenland, *craticulatus* was the only one obtained by the expedition. The single specimen is without the animal. It is slender, with nine thin, irregular varices, the interstices ornamented with strong spiral riblets. This specimen measures as follows: length, 34; width, 18; aperture length, 20; width, 9 mm.

Trophon is not listed by Smith from Grinnell Land. Jeffreys lists *Trophon clathratus* Linné as a fossil from Cape Joseph Henry. The present species, *craticulatus*, is not recorded, apparently, from this part of Greenland and the Etah record appears to be the most northern yet reported from Greenland.

Buccinidæ

The family Buccinidæ, or whelks, has been much abused by some writers, the tendency being to lump all the similar forms under a few species. Some of the earlier writers, especially Dr. William Stimpson, separated the species largely on the basis of sculpture of the surface, which character has been shown by later students of the group, notably Dall, to be one of the most important points for the identification of the species. One of the best papers in which the sculpture is well figured is Dall's account of the Mollusca in the Point Barrow, Alaska, Report. Differences also occur between the sexes which complicate the difficulties of properly classifying the species of this variable genus. As nearly all of the material in the Crocker Land collection consists of shells without the animal the distinguishing sexual characters can not be considered. The sculpture, however, has been carefully examined with a compound microscope and the distinguishing features noted.

At the present time upwards of seventy-five species of *Buccinum* are known, thirty-six of which are from the northern Pacific region (Dall, 1907, p. 139). Posselt (1898, pp. 193-214) credits Greenland with twelve species, as noted below:

<i>undatum</i> Linné	<i>perdix</i> (Beck) Mörch
<i>belcheri</i> Reeve	<i>hydrophanum</i> Hancock
<i>undulatum</i> Möller	<i>ciliatum</i> Fabricius
<i>terræ-novæ</i> (Beck) Mörch	<i>tenue</i> Gray
<i>grænladicum</i> Chemnitz	<i>glaciale</i> Linné
<i>amaliæ</i> Verkrûzen	<i>hancocki</i> Mörch

Of these, *grænladicum* of Chemnitz (not a binomial writer) is better known under the name of *cyaneum* Bruguière and *hancocki* Mörch should be called *grænladicum* Hancock. To these *humphreysianum* Bennett and *tumidulum* Sars should be added. Posselt (1898, pp. 203-209) lists five varieties of *perdix* and the same number of *hydrophanum*, but none of these were found by the Crocker Land Expedition. In a recent work on the fossil Buccinums of Great Britain (Harmer, 1914) three species in addition are credited to Greenland. These are *fragile* (Verkrûzen) MS. G. O. Sars, *elongatum* Verkrûzen, and *tottenii* Stimpson. This work is beautifully illustrated, many of the recent as well as the fossil species being figured. Two new species are described in the present paper. It is apparent that a comprehensive monograph of the species of the genus from American waters is badly needed. Dall has worked out a large buccinoid fauna in the Pacific waters, especially

from the northern part of these waters, and similar work on the northern Atlantic region would produce comparable results.

If the species listed by Harmer from Greenland be admitted to this faunal region, there are nineteen species found in the waters of this large land area. Only six species were obtained by the Crocker Land Expedition, in addition to the two species which are believed to be new to science.

***Buccinum undulatum* Möller**

Plate XXVI, Figure, 6; Plate XXVII, Figure 4

Buccinum undulatum MÖLLER, 1842, Index Moll. Grœn., p. 84.

Buccinum undulatum STIMPSON, 1865, Northern Buccinums, p. 17.

Buccinum undulatum POSSELT, 1898, Conspectus Faunæ Grœn., p. 194.

Distribution.—West Greenland.

Crocker Land Expedition.—Umanak, five specimens, living.

The specimens collected by the expedition appear to be referable to *undulatum* rather than *undatum*. This species has of recent years been considered a synonym of *undatum*; but the Greenland specimens from Umanak are quite different from the common *Buccinum* found in both America and Europe. Compared with specimens from Long Island Sound, the Greenland shells have a rounder aperture, the sinus of the outer lip is narrow and placed near the suture, while in *undatum* it is near the center of the aperture, or at the periphery. The transverse ribs in the Greenland species are broader, flatter, and fewer in number. The sculpture in the New England specimens is more deeply incised, the primary ridges being raised, well rounded, with one to three secondary ridges between. About three secondary ridges occupy the space of one millimeter. In the Greenland specimens the spiral sculpture consists of large, nearly equidistant ridges, the interspaces being as wide as the ridges. Three or four of these ridges occur in one millimeter. The primary ridges are low and not conspicuous; there are two small ridges on the primary ridges and three or four small secondary ridges between the primary ridges (Pl. XXVII, fig. 4). The plan of the sculpture is the same in both *undatum* and *undulatum*. A large specimen measures: length, 68 width, 48; aperture length, 33; width, 20 mm.

Many years ago Stimpson (1865, p. 17) maintained that these two names represented different species although he remarks that "specific tangible differences are hard to find" and adds that "there is a facies, difficult to describe, which makes the forms easily recognizable." Verrill, however (1882, p. 489), remarks that "Our littoral variety is certainly very different, as a variety, from the common shallow-water form of Great Britain, but the latter can be almost exactly matched by our

specimens dredged abundantly on the sandy bottoms, off Cape Cod and south of Marthas Vineyard, while our littoral variety seems to have its counterpart on the northern coasts of Norway and Finmark." From the evidence it would seem that there are two forms found on both American and European shores, typified by *undatum* and *undulatum*. At all events, the specimens brought back by the Crocker Land Expedition are different from the shells usually classed as *undatum* and they fit the shell described by Möller as *undulatum*.

Neither *undatum* or *undulatum* are listed by Smith and Jeffreys from the Grinnell Land region and it seems probable that the Crocker Land specimens represent the most northern locality yet reported.

***Buccinum belcheri* Reeve**

Plate XXVI, Figure 3; Plate XXVII, Figure 6

Buccinum belcheri REEVE, 1855, Belcher's Last Arctic Voyage, p. 394, Pl. XXXII, fig. 7 a; 1877, Ann. Mag. Nat. Hist., (4) XX, p. 133, figs.

Buccinum belcheri TRYON, 1881, Man. Conch., (1) III, p. 193, Pl. LXXVII, fig. 353.

Buccinum belcheri POSSELT, 1898, Conspectus Faunæ Grœn., p. 194.

Distribution.—West Greenland, Port Refuge; Dobbin Bay, Grinnell Land, 30 fathoms.

Crocker Land Expedition.—Etah, two beach specimens.

Among the beach specimens collected at Etah are two specimens of a *Buccinum* which seem referable to Reeve's *belcheri*. They may be described as follows: shell thin, elongated-oval in outline; spire elongated, turreted; suture distinctly impressed; body whorl narrow, elongated, occupying about two-thirds the length of the shell; whorls rounded, somewhat convex, not carinated, plicated or folded; spiral sculpture consisting of thirty-two to thirty-four, flatly rounded, primary ridges; each primary ridge alternates with a secondary ridge which is less than half the width of the primary ridge; a primary and two secondary ridges occupy the space of one millimeter; occasionally, near the base of the shell, the secondary ridges may be double and on the base they may be absent, leaving a wide, shallow groove between the primary ridges; each primary ridge usually has upon it two or three smaller secondary ridges of about equal diameter (Pl. XXVII, fig. 6); the axial sculpture consists of many close-set, incised growth-lines which give the surface a wavy aspect; aperture elliptical, narrow, less than half the length of the shell; columella apparently without plaits.

Length, 50	Width, 29	Aperture length, 27	Width, 14 mm.
47	26	25	14 mm.

This *Buccinum* appears to be one of the most distinct of the genus but seems to have been noticed by few students of Arctic mollusks. The absence of folds or carinæ and the distinct spiral sculpture will easily distinguish it from all other Greenland species. It is related to *ciliatum* Fabricius, but the spiral sculpture is different as is also the surface ornamentation. Verrill's *gouldi* (1882, p. 497) founded on Gould's figure of *ciliatum* (non Fabricius), in the Invertebrata of Massachusetts, may be a related species.

Belcheri is reported by Smith from Dobbin Bay, Grinnell Land, in 30 fathoms, and by Dall (1879, p. 145) from Cumberland Sound. Posselt lists the species from west Greenland. Its distribution in Greenland and other waters has not been worked out. Judging by the paucity of references to this species it must be a rare form in the Arctic regions.

The *Buccinum inexhaustum* Verkrüzen, from Newfoundland, described and figured by Harmer (1910, Pl. x, fig. 3) seems related and may be the same as Verrill's *yerrilli*. If this should be so the species would have to take the name *inexhaustum* as it was given a year earlier (1881) than Verrill's (1882). Verkrüzen's paper seems to have escaped the notice of many writers on American *Buccinum*.

Buccinum cyaneum Bruguière

Plate XXVI, Figure 4; Plate XXVII, Figure 5

Buccinum cyaneum BRUGUIÈRE, 1792, Encyc. Méth., Hist. Nat. des Vers., I, p. 266.

Buccinum cyaneum MÖLLER, 1842, Index Moll. Græn., p. 84.

Buccinum sericatum HANCOCK, 1846, Ann. Mag. Nat. Hist., (1) XVIII, p. 328, Pl. v, fig. 6.

Buccinum cyaneum STIMPSON, 1865, Northern Buccinums, p. 19.

Buccinum grænlandicum G. O. SARS, 1878, Moll. Reg. Arct. Norv., p. 259, Pl. XIII, figs. 9 a-b; Pl. XXV, figs. 1, 2.

Buccinum cyaneum VERRILL, 1882, Trans. Conn. Acad. Arts Sci., V, p. 492.

Buccinum grænlandicum POSSELT, 1898, Conspectus Faunæ Græn., p. 199.

Distribution.—West Greenland, Nanortalik to Port Foulke, 3–90 fathoms; east Greenland, Angmagssalik.

Crocker Land Expedition.—Etah, in beach débris.

A single specimen, apparently referable to *cyaneum*, occurred in the Crocker material. It is short and ventricose with tumid whorls, chestnut colored epidermis and brown dashes on the revolving ridges. The sculpture consists of about thirteen raised primary ridges, separated by wide intervals; the primary ridges have two to three secondary ridges upon them and the interspaces have also the same number of secondary ridges. There are usually about five secondary ridges in the space of one

millimeter (Pl. XXVII, fig. 5). Toward the base of the shell the primary ridges disappear. Axial sculpture consisting of raised, rib-like growth-lines which decussate the surface in connection with the spiral ridges. The aperture and spire are about equal in length and the columella has a strong plait. The shell measures as follows: length, 40; width, 24; aperture length, 24; width, 12 mm.

This shell is called *grælandicum* by many students, but Chemnitz was not a binomial writer and hence his names cannot be used. It is recorded by Smith, as *sericatum*, from Dobbin Bay, Grinnell Land, in 30 fathoms. It is not listed by Jeffreys among the fossils of Grinnell Land and northwestern Greenland. Listed from Port Foulke by Stimpson in 1863.

***Buccinum cyaneum perdix* (Beck) Mörch**

Tritonium grælandicum (Beck) MÖRCH, 1868, Faun. Moll. Islandiæ, p. 211.

Buccinum finmarchianum Verkrüzen, G. O. Sars, 1878, Moll. Reg. Arct. Norv., p. 262, Tab. XIII, fig. 10.

Buccinum cyaneum var. *perdix* VERRILL, 1882, Trans. Conn. Acad. Arts Sci., V, p. 492, Pl. XLIII, fig. 5.

Buccinum perdix POSSELT, 1898, Conspectus Faunæ Græn., p. 203.

Distribution.—Probably the same as *Cyaneum*.

Crocker Land Expedition.—Umanak, on *Laminaria*, July 13, 1914.

A single broken, dead specimen of a *Buccinum* from Umanak appears referable to this variety of *cyaneum*. It is small, without undulations or ribs, and with a thin peristracum similar to that described by Verrill (1882, p. 493) "closely lamellose along the lines of growth." There are rows of short, fine hairs at the intersection of the spiral and axial sculpture, as described by Verrill in New England specimens. The spiral sculpture appears to be the same as in *cyaneum*. In the specimen collected from Umanak the spire whorls are decollated and the lower part of the outer lip is broken. There are three whorls remaining. The specimen measures: length, 28; width, 18 mm.

***Buccinum tanquaryi*, new species**

Plate XXVI, Figures 1, 2; Plate XXVII, Figure 3

Shell large, rather thin, turreted; whorls seven, convex, rapidly increasing in diameter, without axial plications; sutures well impressed; nucleus eroded in all specimens; the body whorl has from six to nine raised spiral ridges usually placed equidistant and marked by long dashes of dark chestnut or red; sculpture consisting of many (five in two millimeters) rather coarse flat ridges or threads, separated by narrow, incised grooves; the width of these ridges is very uniform over the whole shell; many of these ridges are broken up into three smaller ridges separated by incised

grooves (Pl. XXVII, fig. 3); axial sculpture of rather heavy growth-lines which are more or less raised and with the spiral sculpture decussate the surface of the shell; periostracum light olivaceous; aperture yellowish with a tinge of pink or purple, less than half the length of the shell, roundly ovate, somewhat patulous, the outer lip a trifle thickened, sinuous in the adult; pillar lip with a coating of callus, the columella without marked plications, though thick and massive; canal slightly recurved, wide, siphonal fasciole wide, strong.

Length, 67, Width, 39 Aperture length, 33 Width, 22 mm. Holotype, A.M.N.H. No. 2508.

63 37 28 18 mm. Paratype, Univ. Ill. No. Z 10869.

Crocker Land Expedition.—Etah, eight beach specimens; Peewahto Point, five beach specimens.

This species is related to both *cyaneum* and *perdix*, from which it is separated by its large size, sinuous outer lip, and finer sculpture. Half-grown shells somewhat resemble Sars' figure of *finmarchianum* variety *scalaris* (1878, Pl. xxv, fig. 4).

This species, which is believed to be undescribed, is very uniform in size, sculpture and coloration. The shell is usually rather thin, but one specimen in the lot from Etah is quite heavy and has a thicker shell. The number of beach shells collected would seem to indicate that this species is not uncommon in northwest Greenland and it probably will be found in other places.

***Buccinum okblawi*, new species**

Plate XXVI, Figures 7, 8; Plate XXVII, Figure 2

Shell large, rather thin, turreted; whorls seven, convex, carinated; the body whorl has four or five carinæ, the two upper ones of which are raised to form heavy keels, causing the shell to be strongly unicarinate or bicarinate, as one or both of the carinæ are prominent; one carina may form a strong peripheral keel which extends well up the shell toward the spire; when two carinæ are present, one is at the periphery and the other just below the periphery which borders the suture in the upper whorls; there are ten or eleven longitudinal folds on the body whorl, more or less oblique, which extend from the suture to the second carina, but not below (usually), forming tubercles or nodes on the upper carina; spiral sculpture consisting of very many (nine or ten in the space of one mm.) narrow, flattened ridges, separated by deep incised lines (Pl. XXVII, fig. 2); these ridges are not of equal width; axial sculpture of fine lines of growth, which cut the spiral lines, forming a minutely decussated or latticed effect; there is no division into primary or secondary ridges; aperture broad, ovate or roundly ovate, less than one-half the length of the shell, broadest in the center; outer lip patulous, somewhat sinuous, thickened within in the adult shell; pillar lip much excavated above, oblique, with three more or less distinct folds; canal slightly curved, rather wide, siphonal fasciole wide; periostracum smooth. light brown, with dark brown blotches, especially on the spiral carinæ.

Length, 64 Width, 38 Aperture length, 29 Width, 17 mm. Holotype, A.M.N.H.
No. 2502.
68 38 30 19.5 mm. Paratype, Univ. Ill.
No. Z 10872.

Crocker Land Expedition.—Etah and Peeawahto Point, eight specimens.

This large *Buccinum* appears to be related to *polare* Gray, the spiral sculpture being of about the same character, although, perhaps, finer (Dall, 1885, Pl., fig. 6). The spire is much longer in *ekblawi*, the ribs are more prominent, forming heavy nodes on the spiral carinæ, which are also sharper than in *polare*. It is also related to Hancock's *grænlandicum* (1846, p. 329, Pl. v, figs. 8, 9), but is much larger, the spire is longer and the axial ribs are stronger. It is to be regretted that the Crocker Land Expedition did not obtain living examples of this as well as of the previous species, in order that sexual differences, as well as other points in the animal, might have been noted.

Buccinum hydrophanum Hancock

Plate XXVII, Figure 1

Buccinum hydrophanum HANCOCK, 1846, Ann. Mag. N. H., (5) XVIII, p. 325, Pl. v, fig. 7.

Buccinum hydrophanum G. O. Sars, 1878, Moll. Reg. Arct. Norv., p. 261, Tab. XXIV, fig. 8.

Buccinum hydrophanum POSSELT, 1898, Conspectus Faunæ Groen., p. 207.

Distribution.—Jakobshavn to Dobbin Bay, Grinnell Land, 2-300 fathoms.

Crocker Land Expedition.—Etah, Foulke Fjord, dredged in August 1914.

A single young specimen is referred to this species. It contains six whorls, which are much rounded, the last whorl being swollen, and the sutures are well impressed. The surface is smooth except for fine lines of growth and fine spiral ridges, about twenty in the space of a millimeter (Pl. XXVII, fig. 1). A white shining callus is spread over the inner lip. The color of the shell is yellowish white. The nucleus is smooth, of one and a half whorls, light yellow in color, rather flatly rounded, with a distinct suture. The post-embryonic whorl begins without marked break. The specimen collected measures: length, 22; width, 12; aperture length, 11; width, 6.2 mm.

Judging by the size given by Hancock, 2½ inches, and the number of whorls, 7 to 8, the specimen from Etah is quite immature. That it is rare seems evident from the fact that but one specimen was collected, none being found with the beach débris material. Smith records this

species from Dobbin Bay and Franklin Pierce Bay, in 30 fathoms of water. Jeffreys lists it as a fossil from north of Dumb-bell Harbor in latitude 82° 33' N.

***Buccinum tumidulum* G. O. SARS**

Plate XXVI, Figure 5

Buccinum tumidulum G. O. SARS, 1878, Moll. Reg. Arct. Norv., p. 263, Tab. XXV, figs. 5, 6.

Buccinum tumidulum VERRILL, 1882, Trans. Conn. Acad. Arts Sci., V, p. 496.

Buccinum hydrophanum tumidosa var. b. POSSELT, 1898 (?), Conspectus Faunæ Græn., p. 208.

Distribution.—Probably the same as *hydrophanum*.

Crocker Land Expedition.—Etah, Foulke Fjord, 2-10 fathoms, Sept. 7, 1914.

The single specimen obtained by the expedition is referable to Sars' species. It has the smooth surface (microscopic spiral lines similar to those of *hydrophanum* are present, fifteen to twenty in space of one mm.) ventricose whorls, and the wide expansion of enamel on the inner lip described by Sars. The color of the shell is dark brown under a whitish or greenish periostracum. The callus on the inner lip is dark brown. The spire whorls are broken as well as the lower part of the aperture, about four and one-half whorls remaining. The columella is somewhat excavated at the upper part and there is a distinct plait. The shell measures as follows: length, 32; width, 20; aperture length, 18; width, 10 mm. The single specimen was collected alive, the animal being a male, and the operculum with a central nucleus. *Tumidulum* has not been previously reported from northwest Greenland and the Crocker Land specimen appears to be the most northern record recorded.

A large mass of egg capsules was dredged in Foulke Fjord, August 7, 1914, but it is not known which species laid the eggs.

PTEROPODA

Limacinidæ

***Limacina helicina* (Phipps)**

Clio helicina PHIPPS, 1774, A Voyage towards the North Pole, p. 195.

Argonauta arctica FABRICIUS, 1780, Fauna Græn., p. 386.

Limacina arctica MÖLLER, 1842, Index Moll. Græn., p. 77.

Limacina helicina G. O. SARS, 1878, Moll. Reg. Arct. Norv., p. 328, Tab. XXX, fig. 1 a-h.

Limacina helicina POSSELT, 1898, Conspectus Faunæ Græn., p. 263.

Distribution.—Generally distributed in Arct.

Crocker Land Expedition.—Greenland coast, latitude 78° N., August 18, 1913.

This pteropod is reported as very abundant off the coast of Greenland. It is not listed by Smith and may not extend its distribution as far north as Grinnell Land.

Clionidae

***Clione limacina* (Phipps)**

Clio limacina PHIPPS, 1774, A Voyage towards the North Pole, p. 195.

Clio borealis MÖLLER, 1842, Index Moll. Grœn., p. 77.

Clione limacina G. O. SARRS, 1878, Moll. Reg. Arct. Norv., p. 332, Tab. xxix, fig. 4 a-e.

Clione limacina POSSELT, 1898, Conspectus Faunæ Grœn., p. 256.

Distribution.—Generally distributed in Arctic waters.

Crocker Land Expedition.—Etah, in front of house, Sept. 15–19, 1916; collected by E. O. Hovey, latitude 78° N., August 18, 1913; collected by M. C. Tanquary.

This pteropod is very abundant off the Greenland coast—and, with the previous species, forms a large part of the food of whales and some fishes.

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Plate XXV

- Fig. 1. *Astarte crenata* (Gray). A. M. N. H. No. 2483.
Fig. 2. *Astarte crenata* (Gray). A. M. N. H. No. 2483.
Fig. 3. *Astarte crenata inflata* Hägg. A. M. N. H. No. 2523.
Fig. 4. *Astarte fabula* Reeve. A. M. N. H. No. 2491.
Figs. 5-7. *Astarte borealis* (Schumacher). A. M. N. H. No. 2494.
Figs. 8-9. *Astarte borealis sericea* Posselt. A. M. N. H. No. 2489.
Fig. 10. *Astarte arctica* (Gray.) A. M. N. H. No. 2490.



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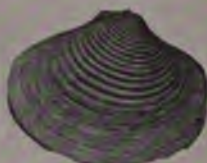
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PLATE XXVI

Fig. 1. *Buccinum tanquaryi* F. C. Baker. Holotype, A. M. N. H. No., 2508.

Fig. 2. *Buccinum tanquaryi* F. C. Baker. Paratype, N. H. Mus., Univ. Ill.,
No. Z 10869.

Fig. 3. *Buccinum belcheri* Reeve. A. M. N. H. No. 2497.

Fig. 4. *Buccinum cyaneum* Bruguière. A. M. N. H. No. 2496.

Fig. 5. *Buccinum tumidulum* G. O. Sars. A. M. N. H. No. 2495.

Fig. 6. *Buccinum undulatum* MÖLLER. A. M. N. H. No. 2507.

Fig. 7. *Buccinum ekblawi* F. C. Baker. Holotype, A. M. N. H. No. 2502.

Fig. 8. *Buccinum ekblawi* F. C. Baker. Paratype, N. H. Mus., Univ. Ill.,
No. Z 10872.



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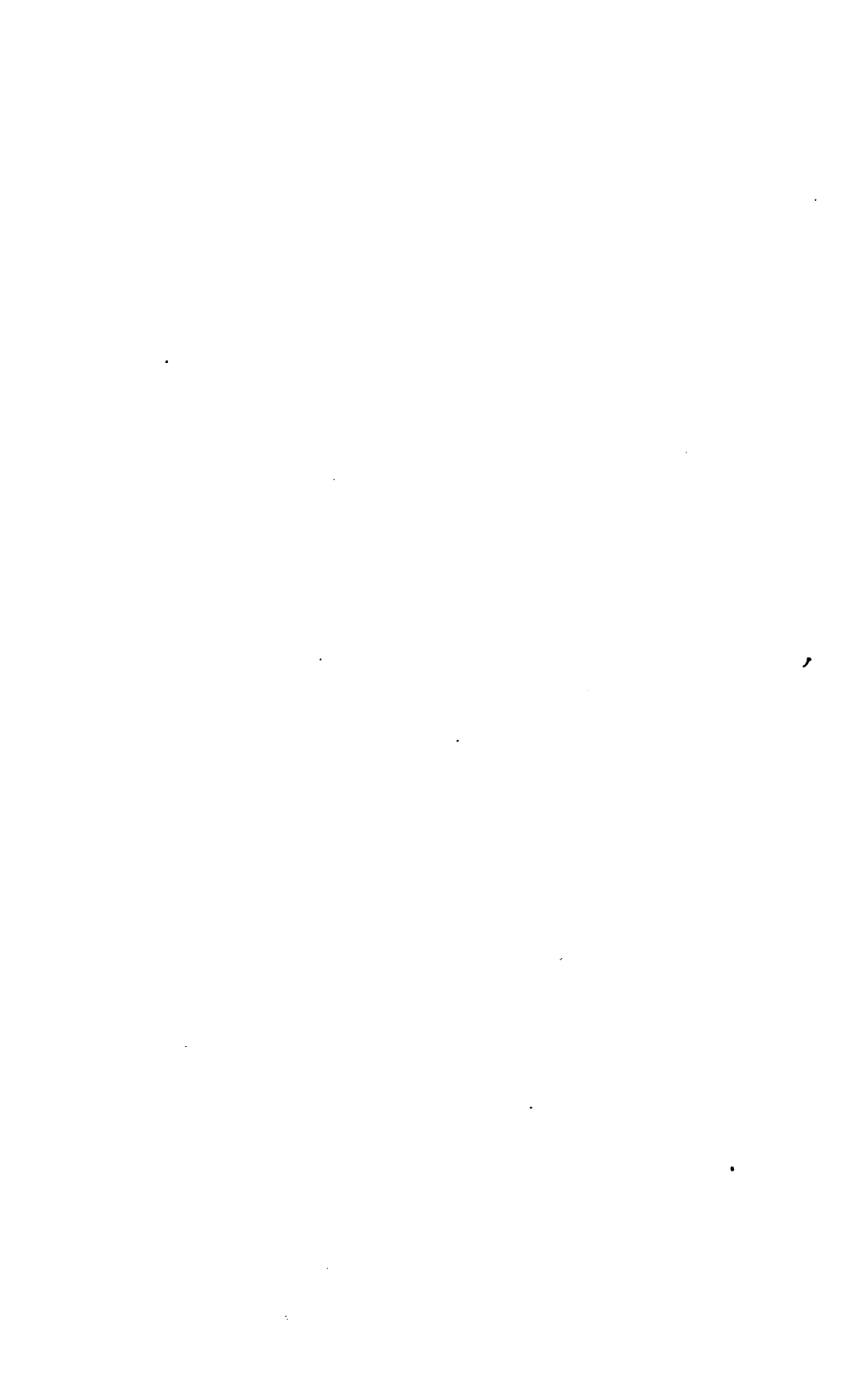


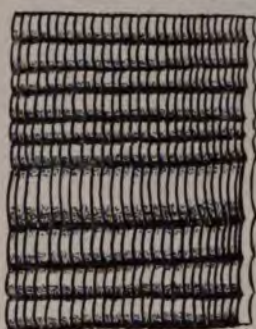
PLATE XXVII

Figures illustrating spiral sculpture of shell, showing number of riblets in one millimeter of vertical surface.

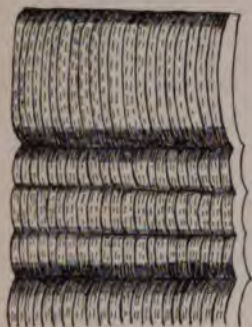
- Fig. 1. *Buccinum hydrophanum* Hancock.
- Fig. 2. *Buccinum ekblawi* F. C. Baker.
- Fig. 3. *Buccinum tanquaryi* F. C. Baker.
- Fig. 4. *Buccinum undulatum* Möller.
- Fig. 5. *Buccinum cyaneum* Bruguière.
- Fig. 6. *Buccinum belcheri* Reeve.



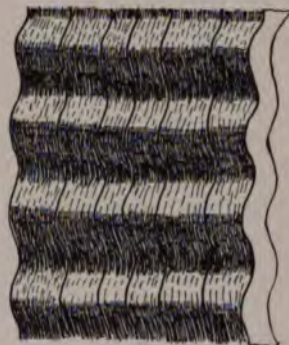
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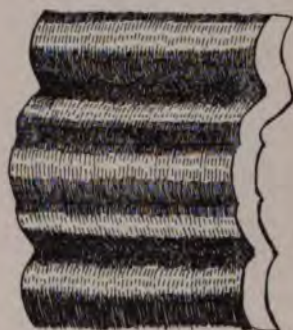
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**Article XII.—DESCRIPTIONS OF NEW AMPHIBIANS AND
REPTILES FROM SANTO DOMINGO AND NAVASSA**

BY KARL PATTERSON SCHMIDT

The Department of Herpetology of The American Museum of Natural History has acquired fairly large collections from the West Indies in recent years. Through the cooperation of various departments of the Museum valuable collections of reptiles and amphibians have been received from several islands. Mr. C. R. Halter was sent to Santo Domingo in the summer of 1916 and brought back a considerable collection from the northeastern part; and to this a small but valuable collection from the Province of Azua made by Mr. R. H. Beck in 1916 and 1917 has been added. Mr. Beck also collected in Haiti and on the island of Navassa, between the southern peninsula of Haiti and Jamaica, adding a number of species to the fauna of this little-known and exceptionally interesting island. Through the kindness of Dr. A. H. Wright, of the Zoological Laboratory, Cornell University, a small collection made in Santo Domingo by Mr. Axel Olsson and the author during a geological reconnaissance of the northwestern Yaqui Valley (Maury, 1917, Bull. Amer. Paleont., V, p. 3 *et seq.*) is available for study in connection with the Santo Domingo material in this Museum. It is intended to supplement the following list of new species with a more extended paper on the West Indian collections.

***Eleutherodactylus montanus*, new species**

Diagnostic Characters

Size moderate; snout obtuse; nostril much nearer the end of the snout than the eye; vomerine teeth in two oval patches well behind the choanæ; tympanum distinct, about one-third the diameter of the eye; toes free; tibio-tarsal articulation reaching the posterior border of the eye; tips of digits considerably dilated; skin rugose above, without longitudinal folds; belly uniformly granular.

Detailed Description

Type: A. M. N. H. No. 6434, ♂.

Head considerably broader than long, broader than the body; snout short, obtuse, its length equal to the interorbital space; canthus rostralis well defined; elbow and knee pressed along sides, overlap slightly; heels overlapping when legs are placed vertically to the body; nostrils closer to the end of the snout than to the eye; tympanum distinct, small, separated from the border of the eye by its own diameter; disks of fingers and toes well developed, about as large as the tympanum; toes with only a vestigial web; inner and outer metatarsal tubercles well developed; a distinct

inner and a shorter outer tarsal fold; vomerine teeth in two oval patches, well behind the choanæ, the space between them less than their diameter; tongue small, oval, very slightly nicked behind; skin rugose above, without glandular folds; belly and lower side of thighs uniformly granular; a very faint median dorsal ridge from end of snout to anus; a subgular vocal sac.

Dorsum light brown with more or less longitudinal darker markings; a broad dark band from eye to eye; venter grayish yellow; a light yellow spot on the anterior proximal part of the thigh; a similar spot on the distal posterior half, and the inner face of the tibia similarly colored; a line of the dark dorsal color extends along the upper side of the thigh, representing the exposed part when the legs are folded; concealed parts of arms also light colored.

Length, 24 mm.; head, 9 mm. long, 10 mm. broad; leg, 34 mm.; arm, 15 mm.

Comparison of Paratypes

Four paratypes, one large female and three smaller specimens, agreeing closely with the description of the type. The female is somewhat larger, total length, 28 mm.; leg, 43 mm.; arm, 18 mm.

Collected in the mountainous interior of the Province of Azua, Santo Domingo, by R. H. Beck, January to June 1917.

***Sphærodactylus becki*, new species**

Diagnostic Characters

Scales large, imbricate; dorsal scales keeled, a vertebral row of small granular scales; ventral scales smooth; dorsal and ventral scales subequal, caudal scales larger; five upper and four lower labials; uniform grayish brown above, light gray below.

Detailed Description

Type: A. M. N. H. No. 12595.

Head pointed, snout as long as the distance between eye and ear opening; ear opening oval, small, oblique; rostral large, with a median cleft above; five upper labials; four lower labials; scales of head small, granular, larger on the snout, gradually passing into the imbricate dorsals; mental large, followed by a pair of small postmentals; dorsal scales as large as the ventrals, imbricate and keeled; one or two vertebral series of small granular scales; ventrals perfectly smooth; caudals transversely enlarged below on the proximal half of the tail; caudal scales about twice as large as the dorsals, smooth; ventral scales perfectly smooth.

Uniform grayish brown above, lighter gray below; dorsal scales are narrowly but sharply dark-edged producing a finely reticulated appearance; throat faintly marbled with darker gray; labials and sides of the head faintly spotted with white; a narrow white line on the canthus rostralis continued from the posterior border of the eye, converging with its fellow on the parietal region, uniting on the neck.

Length, 42 mm.; body, 22 mm.; head, 6 mm. long, 3.5 mm. broad; arm, 6 mm.; leg, 8 mm.

A single specimen from the island of Navassa, collected by R. H. Beck, July 15, 1917.

Anolis longiceps*, new speciesDiagnostic Characters*

Dorsal and lateral scales granular, juxtaposed, the ventrals imbricate, scarcely larger than the dorsals; vertebral rows of dorsals keeled, laterals faintly keeled, ventrals distinctly keeled; a dorsonuchal fold; scales of the vertebral line not enlarged; snout extremely elongate; tail round without crest or denticulation; frontal ridges distinct, supraorbital semicircles in contact; head scales all strongly keeled; two enlarged postanal scales.

Detailed Description

Type: A. M. N. H. No. 12597, ♂.

Habitus somewhat similar to that of *A. porcatius*; body round; hind legs strong, fourth toe reaching the posterior edge of the orbit; head elongate, longer than the tibia, the distance from the nostril to the snout contained five times in its length; tail round.

Head scales all strongly keeled; frontal ridges distinct; supraorbital semicircles in contact, separated from the occipital by two scales, from the supraorbitals by one row of small scales; about six enlarged supraorbitals; ear opening small; three loreals in a vertical row; seven canthal scales; ten upper labials to the middle of the eye; twelve enlarged lower labials; four series of enlarged scales parallel with the lower labials.

Ventral scales small, round, imbricate, keeled, dorsal and lateral scales a little smaller than the ventrals, the median dorsals keeled but not enlarged; a slight fold along the back from the neck to the base of the tail; caudal scales strongly keeled, those of the lower side elongate, the keels forming continuous lines; tail faintly verticillate, three dorsal and four lateral scales in a verticil; two enlarged postanals separated by two small scales.

Color green, back with brown patches, probably uniform green in life; gular fan probably white; venter very light green.

A single specimen, collected on the island of Navassa, July 16, 1917, by R. H. Beck.

Anolis latirostris*, new speciesDiagnostic Characters*

Body depressed, head short and broad, snout spatulate; tail round; dorsal scales granular; ventrals imbricate and keeled; no trace of dorsonuchal fold; supraorbital semicircles separated by about four scales; no frontal ridges; postanals present.

Detailed Description

Type: A. M. N. H. No. 12598, ♂.

Body stout, slightly depressed, head broad; snout strongly depressed, broad anteriorly; hind leg reaching the orbit; tail round, with no trace of dorsal keel or denticulation.

Head scales smooth or faintly keeled; canthus rostralis sharp, canthal scales eight; no frontal ridges; supraorbital semicircles separated by four rows of scales; separated from the occipital by four scales; from the supraorbitals by one row of

small scales; about twelve enlarged keeled supraoculars; six loreals in a vertical row; nine upper labials to the middle of the eye; twelve enlarged lower labials; four rows of enlarged labials parallel to the labials.

Dorsal scales very small, granular, about half as large as the imbricate, keeled ventrals; no trace of enlarged vertebral scales or of a dorsonuchal fold; tail without keel or denticulation; round, faintly verticillate; four or five dorsal scales in a verticil; keels of inferior caudal scales continuous; two large postnals, separated by a single very narrow scale.

Dark bluish green above, mottled with darker; light green with black markings below; throat and chin dark; a very distinct white line on the upper lip, beginning below the eye, continued faintly through the ear; sides with light transverse markings.

A single specimen collected by R. H. Beck on Navassa Island, July 13-19, 1917.

Anolis

new species

Diagnostic Characters

Habitus very slender; head less than three times as long as the body; dorsal and ventral scales small, granular, imbricate, keeled; lateral scales granular; supraorbital semicircles in contact; snout large, flat.

Detailed Description

Type: A. M. N. H. No. 13400, ♂

Habitus of *Anolis semilineatus*, to which it is very closely allied, but more elongate, the tail much longer, body .23 o. l. length, .26-.30 in *A. semilineatus*.

Head scales slightly keeled; frontal ridges faint; canthus rostralis very distinct, three canthal scales; five loreal rows; supraorbital semicircles in contact; occipital large, separated from the supraorbital semicircles by two or three scales; five enlarged supraoculars, separated from the supraorbital semicircles by a single row of scales; ear opening small, oval, oblique; scales of frontal region about twice as large as in *A. semilineatus*.

Nuchal scales granular, followed by about twelve rows of large, keeled, imbricate dorsals; about eighteen rows of imbricate, keeled ventrals, as large as the dorsals; lateral scales small, granular; keels of caudal scales continuous, the median dorsal keel slightly more distinct; limbs covered with large strongly imbricate and keeled scales; posterior face of the thighs covered with granular scales; twelve transversely dilated lamellæ under the fourth toe.

Dorsum light grayish brown; a sharply defined white vertebral line from the enlarged occipital scales to the base of the tail; a similar white lateral line on the upper labials, below the ear, just above the arm, to the groin; arms and legs gray; venter and gular fan pure white.

Length, 169 mm.; body, 39 mm.; arm, 13 mm.; leg, 32 mm.; head, 10.5 mm. long, 5.5 mm. broad.

Type collected by Axel Olsson on the slopes of the Moro of Monte Cristi, Santo Domingo. Several other specimens seen by the author in the arid environs of Monte Cristi; the only additional specimen collected is very poorly preserved. A third specimen in the collection of R. H. Beck, 1917, is probably from Navassa Island.

CHAMÆLINOROPS,¹ new genus

Body compressed, dorsal and ventral scales sharply distinct from the minutely granular laterals; cranial ridges highly developed; tympanum distinct; no dorsal or caudal crest; a gular fan, as in *Anolis*; digits slightly depressed, slightly dilated, the distal phalanx strongly compressed, not raised; no femoral or preanal pores; lateral teeth tricuspid; palate toothless.

Differs from *Anolis* in having the compressed distal phalanges inserted at the end of the expanded part of the digit; from *Norops* in the highly developed cranial crests, the modified lepidosis, and the type of coloration: differs from *Tropidodactylus* in the smooth digital lamellæ, the dilation of the digits, and the toothless palate; widely different from *Chamaeleolis* in lepidosis and digits, but related to it in having a circular eyelid with radiate pattern.

Type: *Chamælinorops barbouri*, new species.

Chamælinorops barbouri,² new species*Diagnostic Characters*

Characters of the genus.

Detailed Description

Type: A. M. N. H. No. 12602, ♂.

Body extremely compressed, the sides vertical or concave, two and a half times as deep as wide at mid-body; head with rugose cranial ridges; tail long; legs large, the adpressed hind limb reaching the anterior border of the orbit, the adpressed front limb reaching the insertion of the leg.

Lepidosis heterogeneous. Six rows of large dorsal scales, with no trace of crest; the two middle rows narrower, and with more or less distinct keels, the next two rows wider than long, with very distinct keels forming a continuous line; the lateral rows with horizontally directed keels, forming a sharp angle between the dorsum and the sides; twelve rows of strongly keeled imbricate ventrals, slightly mucronate, the keels forming continuous lines; lateral scales minute, granular, smooth, 30-35 between the ventrals and dorsals; scattered large keeled scales especially on the lower half of the sides; a row of small keeled scales borders the dorsals below the dorsolateral angle; limbs entirely covered with imbricate keeled scales, the keels usually continuous; head covered with flat keeled scales; throat with rows of small keeled scales; edge of gular fan with two rows of almost spinose scales. Tail covered with imbricate keeled scales, not at all verticillate; two enlarged, multicarinate postanals.

Digits long, slightly depressed, and very slightly expanded, the terminal phalanges strongly compressed and strongly clawed, inserted at the end of the expanded portion; third and fourth fingers nearly equal; fourth toe much the longest; fifth toe set at right angles to the others.

Head sharply V-shaped in outline, strongly ridged; canthus rostralis sharp, with three large scales; loreal region concave; a large anterior supraciliary scale, followed by smaller ones; about six enlarged keeled scales on the supraorbital area; supra-

¹Named for its apparent relations with *Chamaeleolis* and *Norops*.

²Named for Dr. Thomas Barbour of the Museum of Comparative Zoology at Harvard, well known for his contributions to Antillean Herpetology.

orbital semicircles separated by two scale rows; separated from the occipital by three or four rows of scales. No frontal ridges; supraorbital ridges sharp, slightly rugose; two nearly straight ridges from the posterior corners of the supraorbital ridges to the occiput, where they end in two closely approximated tubercles; a very strong lateral ridge from the middle of the orbit posteriorly, extending horizontally backwards, set with strong tubercular scales; a faint vertical ridge from the end of the latter in front of the ear opening; eight upper and nine lower labials to below the center of the eye; eyelid circular, its opening about twice the diameter of the ear opening, covered with very minute uniform granules.

General color light brown. A dark chocolate-brown line along the lateral ridge, along the under side of the dorsolateral angle, to the base of the tail. A dark spot above the insertion of the arm, one in the axilla, and two vertically elongate spots on the sides between the arm and leg; a similar spot above the insertion of the hind limb, extending along the lateral ridge, and sending down a vertical process to the leg; a dark spot on each side of the base of the tail; a faint cross-band between the eyes, and two dark cross-marks on the back; a dark line from eye to ear; tip and sides of snout darker; a faint oblique line on the loreal region from the orbit to the labial border; eyelid with seven radial brown lines; gular fan probably black; throat, roof of mouth, and base of tail black.

Length, 181 mm.; body, 47 mm.; leg, 36 mm.; arm, 22 mm.; head, 15 mm. long, 10 mm. broad.

Comparison of Paratypes

The single paratype, a juvenile specimen of 80 mm. total length, has a very dark venter, the back almost white, the three dorsal transverse markings very distinct, the lateral marks absent, except for the one above the hind leg; the radial markings of the eyelid continue to the labial border below; and are continuous with the line from eye to ear and the line along the lateral ridge behind; chin transversely barred; tail with irregular dark rings.

Both specimens collected on the island of Navassa by R. H. Beck, July 13-19, 1917.

Ameiva navassae, new species

Diagnostic Characters

Caudal scales straight, keeled; ventral plates in ten longitudinal and thirty-four transverse series; three supraoculars; three tibials much enlarged; mesopterygium with enlarged scales; ventral color light bluish, throat and collar yellow; seven light narrow dorsal lines.

Detailed Description

Type: A. M. N. H. No. 12607, ♂.

Profile of head strongly curved, ear-opening small. Rostral forming an acute angle behind; anterior nasals narrowly in contact behind the rostral; frontonasal longer than wide, in contact with the large loreal; prefrontals broadly in contact; frontal in contact with two supraoculars on one side, with three on the other; three large supraoculars, and a very small fourth behind them; frontoparietals separated from the third supraocular by a row of granules; six supraciliaries, the first between the first supraocular and the loreal, separated from the posterior supraoculars by a

row of granules; five occipitals, the outer smallest, followed by about two rows of irregular postoccipitals; six large upper labials to the middle of the eye; five enlarged lower labials to the same point; wedge of granular scales between the chin shields and the lower labials extending to the first pair of chin shields; chin and throat covered with granular scales, a distinct band of enlarged scales across the middle.

Dorsal scales minute, granular, uniform; ventral plates in ten longitudinal series, including the small lateral series, and thirty-four transverse series; collar with transverse rows of enlarged scales; seven brachials, in a single series; antebrachials in two rows, eight in the upper, which is continuous with the brachials; anterior face of the thigh covered with seven rows of flat scales; tibia with two or three rows, three scales of one row much larger than the others; a pair of posterior postanals, and two median ones in front of them; twenty-eight scales in the fifteenth verticil of the tail.

Ventral plates and under sides of the hind legs light blue; breast washed with yellow; collar, throat, and chin shields straw-color, with a tinge of pink; dorsum black; a sharp dorsolateral white line on each side extending from the supraciliaries on to the basal half of the tail; between these a pair of sharp white lines, slightly narrower, from the postoccipitals to the base of the tail; a vertebral line between these more or less distinct, but not sharply defined, beginning at the shoulders and extending to the base of the tail; a lateral line on each side, beginning at the ear, absent above the arm, continued along the side half-way between the dorsolateral line and the ventral plates; this lower line continues on the proximal anterior face of the thigh; posteriorly it is replaced by a line on the posterior face of the thigh, extending along the tail, gradually fading; upper sides of arms and legs brown, vermiculated with black.

Length, 240 mm.; body, 83 mm.; arm, 29 mm.; leg, 60 mm.; head, 22 mm., long, 13 mm. broad.

A single specimen collected on the island of Navassa by R. H. Beck, July 13-19, 1917.

Article XIII.—FRESH WATER MOLLUSCA FROM COLORADO AND ALBERTA¹

BY FRANK COLLINS BAKER

I.—COLORADO

During the months of July and August, 1916, Professor Frank Smith, of the Department of Zoology, University of Illinois, while engaged in biological work at the School of Mountain Biology of the University of Colorado, at Tolland, Gilpin County, collected a number of mollusks that are of more than passing interest, several of the species being new to the Colorado fauna and two new to science. Professor Smith made careful field notes concerning the different lakes visited and these are of value in connection with the ecology of these mollusks. These notes, as far as they relate to the collection herein considered, appear below, contributed by Professor Smith.

Examinations were made of about 25 small mountain lakes and ponds which are at altitudes varying from 8100 to 11,350 feet and are within a few miles of the mountain laboratory of the University of Colorado. The laboratory which was the center of activity is located at Tolland on the Denver and Salt Lake (Moffat) R.R., and from it a part of the continental divide with numerous associated high-altitude lakes and streams are easily accessible. The locations and relations of these bodies of water are well shown on the topographic maps (U. S. Geol. Survey) of the Central City and Blackhawk quadrangles.

Attention was divided among several groups of Invertebrata besides Mollusca and it is not improbable that a more extended and thoroughgoing search would result in finding at least Sphæriidæ in some of the places where they were not found in 1916. In the majority of the lakes no mollusks whatever were found. Apparently the Unionidæ are not represented at all, while Sphæriidæ were found in about 30 per cent of the lakes and ponds examined, including one of 10,850 feet altitude.

Physa and *Galba* were limited to three bodies of water of which none has an altitude of over 9600 feet. *Planorbis* of moderately large size was found in but one, and that is near the lower limit of altitude; while *Planorbis* species of small size were found in five and quite probably are present in still others although, unfortunately, specimens were retained from only three. No aquatic snails were found above an altitude of 9600 feet. The collecting operations were limited to the shallow parts of the lakes where the depth did not exceed four feet, but this included the greater part of the areas having rooted plants or coarser forms of algæ.

Pactolus Pool lies close to the railroad, about two miles east of Rollinsville and seven miles east of Tolland, and the area is approximately two acres. The collection was made in the absence of the writer by students who presumably made no effort to collect the small forms.

¹Contribution from the Museum of Natural History, University of Illinois, No. 5.

Smartweed Lake, which yielded the greatest variety of mollusks, is slightly more than one mile north from Rollinsville (five miles east-northeast from Tolland), has an area of but two or three acres and an altitude of about 8575 feet. Throughout most of its area, the lake is rather shallow and has a good deal of coarse emergent vegetation and considerable quantities of coarse algae. The general conditions resemble those of lakes of lower altitude more than do those of most of the lakes visited.

East Lake is a shallow pond of less than an acre in area, and located about a quarter of a mile east of the laboratory, with an altitude of about 8850 feet.

Park Lake is about one-fourth of a mile northeast from the laboratory, has an area of approximately ten or twelve acres, and an altitude of 8850 feet. The vegetation is rather scanty in amount. Although this lake was examined more frequently and more thoroughly than any of the others, it yielded but one species of snail, a small *Planorbis*, and a species of *Pisidium*, or neither of which any specimens happen to have been preserved. Small near-lying ponds also contained a small form of *Planorbis* and a *Pisidium*, of the latter of which specimens were preserved and are listed in this paper.

Lily Lake (near Lake Eldora) is a small pond about two miles north by east from Tolland and at an altitude of about 9375 feet. It is shallow and has a considerable amount of vegetation.

The Teller Lakes are about two miles southwest from Tolland, and are at an altitude of slightly less than 9600 feet. The largest of these lakes (Teller Lake) has an area of approximately four acres and a considerable part of it is shallow with scattered rooted plants and considerable algae. Three specimens of a new species of *Physa* were found here on June 30, 1916, but at a second visit, July 26, none were found although a search was made for them. No other species of snails were found in these lakes and no snails whatever in any others with an altitude of over 9500 feet. Teller Lake and North Teller Lake each yielded two species of Sphaeriidae, the latter lake being much smaller (area less than an acre) with less shallow water and almost no coarse vegetation.

East Crater Lake is about four miles west by south from Tolland, at an elevation of about 10,450 feet. It is but little more than a mile from the crest of the divide and presumably has climatic conditions that are too severe for mollusks other than *Pisidium*. North Forest Lake is a little more than four miles west by north from Tolland at an elevation of about 10,850 feet, is only about a mile from the divide, and also yielded no mollusks other than *Pisidium*.

Eight other lakes and ponds of an altitude of more than 10,850 feet (James Peak Lake, Echo Lake, Corona Lake and Reservoir, two of the Arapahoe Lakes, and two of the Crater Lakes) apparently are without mollusks. In but two of the eight lakes and ponds having the lowest altitudes of the series was there an apparent dearth of molluscan life, and the search in these two was limited to a very small part of the shore and a very brief time interval.

It is but fair to state that the collection was made without realization that it might prove to contain new forms, or be otherwise of special interest, and hence it received less time and attention than it otherwise might, and it is quite probable that more extended collecting operations may increase the number of lakes found to contain mollusks and also increase the number of species found in some of them.

My thanks are due Dr. V. Sterki for the identification of the Sphaeriidae as well as for some of the notes on this family contained in the text.

TABLE OF DISTRIBUTION

	Colorado Record	Pactolus Pool 8100 ft. Alt.	Smartweed Lake 8575 ft. Alt.	East Lake 8850 ft. Alt.	Tolland Ponds 8880 ft. Alt.	Lily Lake 9375 ft. Alt.	Largest Teller Lake 9600 ft. Alt.	North Teller Lake 9550 ft. Alt.	East Crater Lake 10,450 ft. Alt.	North Forest Lake 10,850 ft. Alt.
<i>Musculium raymondi</i>	Second							A		
<i>Pisidium tenuissimum</i>	First		C							
<i>Pisidium huachuacanum</i>	Second				14	3		4		2
<i>Pisidium rotundatum</i>	First					5				
<i>Pisidium variabile</i>	Third						4			
<i>Pisidium</i> (possibly new)	First						1		3	
<i>Galba palustris</i>	Common	4	7							
<i>Planorbis plexata</i>	Second		1							
<i>Planorbis vermicularis</i>	First					14				
<i>Planorbis similaris</i>	New		A	A						
<i>Physa ampullacea</i>	First	2								
<i>Physa smithi</i>	New						3			
<i>Physa traskii</i>	First		7							
Number of species.....		2	5	1	1	3	3	2	1	1
Collecting period, hours.....			2	3	2	1	2	1	1	½

A, abundant (more than 40 specimens); C, common (more than 20 specimens); figures indicate number of specimens found.

In the table, the relation of the species to altitude, time given to collecting, etc., are shown.

Specimens of the Colorado Mollusca have been deposited by Professor Smith in The American Museum of Natural History.

***Musculium raymondi* Cooper**

North Teller Lake, altitude 9550 feet.

Dr. Sterki says of this species "This *Musculium* may be a form of *ryckholti* Norman, common in northern Europe and very variable." *M. ryckholti* has been recorded from Michigan and parts of Canada. Henderson (1907, p. 95) lists *M. ryckholti* from Saguache, Colorado, following Sterki (1903, p. 93), but the latter author refers the Colorado specimens to *raymondi* rather than to *ryckholti*, although calling attention to the relationship of the two species. The shells of this species are peculiar in being very round with short, rounded, and slightly imbricate beaks. This is apparently the second record for the State of Colorado.

***Pisidium tenuissimum* Sterki**

Smartweed Lake, altitude 8575 feet.

Of this species Dr. Sterki remarks, "the find is of more interest than a new species would be." The Colorado specimens much resemble individuals from small lakes in Michigan. This species is widely distributed, occurring as far north as Yukon Territory (*vide* Sterki). The present specimens furnish the first record for Colorado.

***Pisidium huachucae* Pilsbry and Ferriss**

Small ponds near Tolland, altitude 8880 feet; North Forest Lake, altitude 10,850 feet; North Teller Lake, altitude 9550 feet; Lily Lake, altitude 9375 feet.

This is the second record of this species from Colorado, the first being by Mr. E. E. Hand (1914, p. 144) from Jefferson County at an altitude of 7500 feet. Mr. Hand found these shells in a little pond about 10 by 12 feet, and Professor Smith found them in similar small ponds near Tolland (Henderson, 1912, p. 55).

***Pisidium rotundatum* Prime**

Lily Lake, altitude 9375 feet.

Several small specimens of this species, of an exceptionally light color, were collected from this small lake. This is the first record from Colorado.

***Pisidium variabile* Prime**

Largest Teller Lake, altitude 9600 feet.

This is the third record of this species from the State.

***Pisidium* species**

East Crater Lake, altitude 10,450 feet; Largest Teller Lake, altitude 9600 feet.

Several specimens of a *Pisidium* were found at these localities which cannot at present be placed in any species.

The *Pisidium* fauna of Colorado now numbers ten species, four of which occur in the neighborhood of Tolland; two species new to the State are included in this number. A careful search of the many mountain ponds and lakes which occur in Colorado would doubtless bring to light a number of species of this genus heretofore unknown in the State.

***Galba palustris* (Müller)**

Pactolus Pool, altitude 8100 feet; Smartweed Lake, altitude 8575 feet.

This protean Lymnæid was abundant in these bodies of water. The shells are typical of the species.

***Planorbis plexata* Ingersoll**

Smartweed Lake, altitude 8575 feet.

A single specimen from this lake seems referable to the species described by Ingersoll (1874, p. 402). The specimen at hand, as well as those described by Ingersoll, seems separable from *trivolis*. In *plexata* the last whorl partly envelops the preceding whorls causing the last whorl to be very disproportionate in size; while in *trivolis* the whorls are regularly and evenly coiled, normally. In *plexata* the umbilical opening is large and deep while in *trivolis* it is small. The aperture of *plexata* is also rounder than in *trivolis*. Viewed from the aperture the last whorl in *plexata* is seen to bend to the left while in *trivolis* it continues in the regular discoidal plane of the whorls. The color of the shell in *plexata* is greenish-horn and the shell is quite thin.

Since the publication of Ingersoll's paper in 1874, little has been said or written about this *Planorbis*, it being generally considered a synonym of *trivolis*, as have been all the larger species of this genus. What relation this species may bear to *Planorbis tenuis* Philippi, I can-

not say, typical specimens of that species not being at hand for comparison. *P. tenuis* was described from Mexico and it may extend its range northward. Tryon (1870, p. 200) says "all the west coast specimens included by Mr. Binney in *Planorbis trivolvis*, are referable to this species, which entirely replaces *trivolvis* west of the Rocky Mountains." The figures on Plate VI (7-9) of the Monograph are similar to *plexata*, but whether these are the same as the Mexican *tenuis* is another question. It seems scarcely possible that the Mexican species should extend its range as far north as Colorado and the west coast *trivolvis* cited by Tryon may perhaps more properly be called *plexata*. The Colorado specimen here identified as *plexata* is certainly distinct from the eastern *trivolvis* and should be designated under a separate name. The type locality is St. Mary's Lake, Colorado. The same shell from a pond near Lake Como, Bitter Root Mountains, Montana (collected by L. E. Daniels, 1912).

***Planorbis vermicularis* Gould**

Lily Lake, altitude 9375 feet.

A dozen specimens of a small *Planorbis* from this lake are referred to *vermicularis*. This species is common in Oregon and northern California and is cited by Dall (1905, p. 95) from Vancouver Island, B. C. It will probably be found to be widely distributed in the states west of the Rocky Mountains.

The Lily Lake specimens are reddish-horn in color and are smaller than specimens from Oregon, the largest specimen measuring 4 mm. in greatest diameter. This is the first record from Colorado but it will probably be found in many other places. It has doubtless been catalogued by many as *parvus* which it somewhat resembles, and to which it is referred as a synonym by some conchologists. A comparison of authentic specimens of the two species, however, shows them to be quite distinct.

***Planorbis similis*, new species**

Figure 1

Smartweed Lake, altitude 8575 feet; East Lake, near Tolland, altitude 8850 feet (immature).

Shell thin, yellowish or brownish-horn, translucent in immature shells, opaque in adult shells; upper surface slightly concave in the middle, lower side concave; whorls 4, regularly increasing in diameter, rounded above and below; periphery rounded near the base of the shell, the body whorl sloping upward at an angle of 45 degrees in some specimens, and abruptly rounding into the base of the shell below;

umbilicus very broad, not very deep, showing all of the whorls; aperture ovate and oblique in the immature shell, round and parallel with the whorls in the adult shell; sculpture consisting only of fine growth-lines; lip simple, not thickened within.

Height, 2.5; greatest diameter, 6.2; aperture height, 2; diameter, 2 mm.

Holotype.

Height, 1.7; greatest diameter, 4.7; aperture height, 1.4; diameter, 1.5 mm.

Paratype.

This small *Planorbis*, which occurs so abundantly in Smartweed Lake, appears to be undescribed. Its nearest relative, curiously enough, seems to be a postglacial fossil found in Illinois, *Planorbis altissimus* (Baker, 1919, p. 94). It differs from that species in having a rounder aperture, a rounder periphery, *altissimus* having a bluntly angular periphery, and in the aperture which is regularly arched, ovate or round in *similaris* while in *altissimus* it is strongly shouldered at the suture and the aperture is quite oblique, and there is a blunt angle at the lower part of the outer lip. Adult *similaris* is much larger than *altissimus*; in specimens of the size of adult *altissimus*, *similaris* has a shell two-thirds grown, and the aperture is regularly rounded above, while in *altissimus* there is a distinct shoulder. The last whorl of *altissimus* is also narrower and the whorls are more tightly coiled than in *similaris*, the sutures, also, not being as deep. *Similaris* differs from *parvus*, [which it somewhat resembles, in its larger size, rounder aperture, and the peculiar reamed-out appearance which is so characteristic of the lower surface of *parvus*.

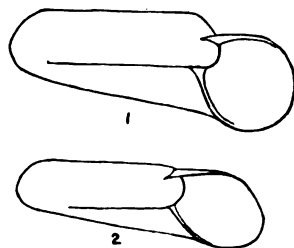


Fig. 1. *Planorbis similaris* Baker, 1, holotype, adult; 2, paratype, immature; $\times 6$.

The shell of *similaris* is of the same size as that of *hirsutus* and of *deflectus*, but those species have a more or less distinct carina at the periphery, and the aperture and body whorl are quite differently shaped. This is evidently the *Planorbis* cited by Henderson (1912, p. 62), under *Planorbis parvus*, from Tolland, collected by Dodds. *Similaris* will probably be found in collections labeled *parvus*. The writer has seen no authentic *parvus* from Colorado or other western states, although it may be found there. Most of the small *Planorbis* with rounded periphery have been called *parvus* and a revision of all these small forms will doubtless reveal several species included under this all-embracing name, as has been the case with *Lymnaea palustris* and other fresh-water pulmonates.

***Physa ampullacea* Gould**

Figure 2

Pactolus Pool, altitude 8100 feet.

Under this name Binney (1865, p. 79) has figured two species, neither of which exactly conform to Gould's diagnosis. Gould describes the spire as elevated and acute, the last whorl as inflated, the sutures decidedly impressed, and the aperture as broadly ovate. He says further that "It accords most nearly with Haldeman's Plate III, fig. 9, which was given him as *P. sayii*. Tannan." Comparing the diagnosis with the figures it is evident that neither is *ampullacea* and figure 134 is too compressed and the last whorl is somewhat dome-shaped. Wishing to settle the status of this species, I wrote to Dr. Paul Smith, United States National Museum, who very kindly compared the specimen deposited by Gould in the Smithsonian collection with Binney's figure. Dr. Bartsch reports as follows:

Your letter of the 14th came to me this morning, and I have made the examination of *Physa ampullacea* Gould you wish, with the following results. Figure 134 is evidently not based upon any specimen in the Smithsonian collection. Cat. No. 9170, U. S. N. M., contains Gould's cotypes. Figure 134 represents one of the specimens which has the right margin of the last whorl, as well as part of the outer lip near the base broken. This might justify the artist, in a measure, in drawing the narrow outline represented by him. Personally I think the figure should be more gibbose and not so flattened on the right side. Figure 135 is evidently also based upon a fragment of which practically only half of the shell remains. The outline of this corresponds beautifully with the figure, but the detail may have been pencilled in from the other individual. It is also possible that this specimen may have been broken after the figure was made.

I would say, looking at the two, that figure 135 probably represents more nearly the norm of the species than 134, but the two are undoubtedly the same thing, 134 being simply a faulty drawing.

Tryon, in the continuation of Haldeman's Monograph, evidently figures the same two specimens (Plate VI, figs. 5-6) and remarks that Binney's figure 133 represents *Physa traskii* Leä. Figure 6 is said to represent a distorted specimen (Haldeman's Mon., p. 129).

Two specimens collected by Professor Smith are undoubtedly *ampullacea*, answering perfectly to Gould's diagnosis. They resemble Binney's figure 135, but the spire is more acute and longer, the last whorl is more gibbous, and the sutures are very well impressed. One speci-



Fig. 2. *Physa ampullacea* Gould: X 1½

men has the outer lip flattened near the suture somewhat as in Binney's figure 134. The two specimens measure as follows:

Length, 23; width, 14; aperture length, 18; width, 9 mm. (specimen figured).

Length, 19; width, 11; aperture length, 14; width, 7 mm.

The columella is marked by a very strong, gyrate plait and the inner lip is folded back over the parietal wall, forming a widespread callus which completely closes the umbilical chink.

Physa ampullacea is, then, a valid, very characteristic species of the western American region, not particularly related to any other species though resembling in a way large specimens of *Physa sayii* Tappan, as suggested by Gould. The few authentic records indicate a wide distribution; these are, St. Michael, Norton Sound, Alaska (Dall, 1905, p. 103), British Columbia (Whiteaves, 1906, p. 117), Nevada (Walker, 1916, p. 5), Montana (Elrod, 1902, p. 173), Oregon (Binney, 1865, p. 79), Washington, California, Utah, and Idaho (Henderson and Daniels, 1917, pp. 51-65). It is thus seen to occur from Colorado to California and northward to Alaska. The suggestion that Lea's *Physa nuttalli*, from Lewis River, Oregon, is the same as *ampullacea* seems scarcely possible, if Lea's figure in the Observations (Plate xxiv, fig. 93) correctly represents the species. Both *ampullacea* and *nuttalli* are listed from British Columbia by Whiteaves (*op. cit.*, p. 117), the latter identified by Dall. *P. ampullacea* is probably widely distributed in Colorado where it may have been identified as the protean *gyrina*.

***Physa smithi*, new species**

Figure 3

Largest Teller Lake, altitude 9600 feet.

Shell compressed, cylindrical, elongated, thin; color dark horn to blackish or blotched with dark: spire short, broadly conic; whorls probably (spire decollated) 5-6, narrow, the last whorl narrow and compressed, cylindrical; sutures well impressed; the slope of the whorl is at such an angle that a line drawn from the spire to near the periphery of the body whorl would touch the greater portion of the whorls; aperture long, seven-ninths the length of the whole shell, narrow above, expanded below, the slope of the upper part of the outer lip continuing the general slope of the spire without marked break; outer lip flattened in the center, margined with red; columella reflexed over the body whorl, forming a distinct, heavy, twisted or gyrate plait, and leaving a very narrow flattened umbilical chink at the base of the fold; the inner lip forms a wide spreading callus over the body whorl; sculpture consisting of heavy impressed spiral lines; in old specimens the growth-lines form heavy longitudinal streaks in a somewhat zebra fashion.

This *Physa* has probably been called *gyrina*, but the whole shape of the shell is different, the aperture, the heavy plait on the columella, the heavy columella, the peculiar shape of the upper part of the body whorl, all different from the common Mississippi Valley species. It is very related to *Physa*, but the body whorl is cylindrical, not conical, the shape of the aperture is different. It appears to be the same size as *Physa*, but the outer lip is not expanded at the upper part, and the body whorl is swollen, not conical, as is *Physa*. Additional material to be a variety of *Physa* at hand appear to mark it as a new species.



Fig. 3. *Physa smithi* Baker, holotype: $\times 2$.

The specimens collected by Professor Smith provide the first authentic record for Colorado. It is interesting to note that the locality is on the eastern side of the continental divide. Henderson (1907, p. 183) recorded *virgata* from several parts of Colorado, but the reference to this species is said to be doubtful.

Two species of land shells were collected on the shore of Pactolus Pool. These are:

Zonitoides arborea (Say) and

Pyramidula cronkhitei anthonyi Pilsbry.

II.—ALBERTA, CANADA

Among several land and fresh-water mollusks collected in Alberta and submitted to the writer by The American Museum of Natural History for identification, there is a small lymnaeid that is apparently undescribed. This portion of Canada undoubtedly has a large fauna of fresh-water pulmonates—*Lymnaea*, *Planorbis*, *Physa*, etc.—and many new forms of these genera will be found when this wide territory is more thoroughly searched for mollusks and other invertebrate life.

Galba alberta, new species

Figure 4

Shell elongate in outline; periostracum yellowish-horn in color; surface marked by heavy growth-lines crossed by distinct incised spiral lines; whorls five and a half, regularly increasing in size, a trifle shouldered below the suture; spire broadly acutely

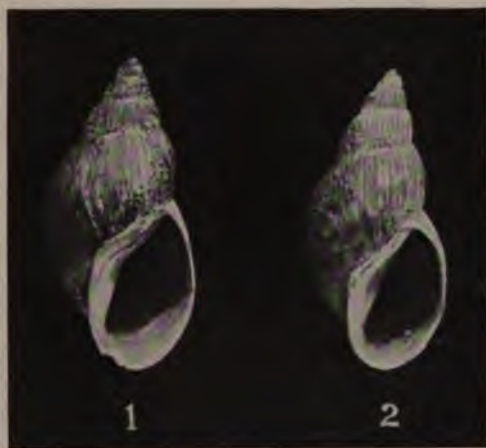


Fig. 4. *Galba alberta* Baker, 1, holotype; 2, paratype; $\times 3\frac{1}{2}$

conic, about as long as the aperture; nuclear whorls a trifle more than one volution, rounded, smooth, wine-colored; sutures impressed; aperture ovate, rounded above and below; outer lip thin, with acute margin; inner lip broadly reflected over the parietal wall forming a spreading callus; the lower part of the reflection is erect, forming a broad, smooth, rounded pillar lip without a plait; there is a small, open umbilical chink.

Length, 12; width, 6.5; aperture length, 6.0; width, 3 mm. Holotype A. M. N. H., No. 2529a.

Length, 11.5; width, 5.7; aperture length 5.5; width, 2 mm. Paratype A. M. N. H., No. 2529b.

Radula formula: $\frac{11}{3-6} + \frac{2}{3} + \frac{10}{2} + \frac{1}{1} + \frac{10}{2} + \frac{2}{3} + \frac{11}{3-6}$ (23-1-23). The lateral

teeth are bicuspid, the mesocone rather long and wide, the ectocone short and wide; the 11th and 12th teeth are transition, tricuspid, the entocone placed rather high up on the mesocone; the 13th to 23rd teeth have the cusps at the distal end, 3-6 in number, varying in size as in the marginal teeth of all lymnaeids. The radula most nearly resembles that of *Galba cubensis* in Plate VII, F, of the author's Monograph of American Lymnaeidae.

Brazean Lake, Alberta, Canada.

This lymnaeid is a typical an hour-glass-shaped pillar individuals of *Galba caperata* the form of the inner lip, and in *Galba cubensis aspirans* Pilsbry, resembles figure 18 on Plate 1. The resemblance is, however, only superficial. It is heavily spirally striated and differs from all other species in its elongate-ovate outline, spiral lip. Spiral striation appears to be rare among the species of typical *Galba* and for this reason the new species is of special interest.

Having bicuspid lateral teeth and a plait. It resembles some individuals in the texture of the surface, and in shape. It is most nearly like the holotype of *alberta* quite closely in the writer's Monograph. The surface of *alberta* being smooth. The new species may be easily recognized by its elongate-ovate outline, and smooth, folded inner lip.

Galba (Stagnicola) traskii (Tryon)

Several specimens of this western lymnaeid were collected in the Brazean River, Alberta. They resemble figure 8 on Plate xxxix of the Lymnaea monograph before referred to. As far as known to the writer, this is the second record from Alberta (and also from Canada), a previous citation being Banff (Baker, *op. cit.*, p. 369). *Traskii* is probably widely distributed in western Canada, and it is to be looked for especially in the lakes and rivers of British Columbia and Alberta.

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**Article XIV.—NEW SPECIES OF CLÆNODONTS FROM THE
FORT UNION (BASAL EOCENE) OF MONTANA**

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PLATE XXVIII

The genus *Clænodon* was proposed by Scott, in his revision of the North American creodonts¹ to include two or, at most, three species, *Mioclænus ferox*, *M. corrugatus* from the Torrejon, and *M. protoconioides* from the Puerco. These species had earlier been described by Cope² and were grouped by him under the genus *Mioclænus* together with a heterogeneous lot of species representing, as recognized by Scott, at least four families belonging to two orders. Since the time of Cope, the characters of these early Eocene mammals have become better known through the discovery of more complete material, and this wider knowledge has formed the basis of much discussion, by later writers, regarding the possible relationships of the creodonts in general, and particularly the position occupied by the Arctocyoniidæ, the family to which the genus *Clænodon* belongs. Regarding the affinities of *Clænodon*, and especially its possible relationship to the modern bears, there has been much uncertainty, and opinions have differed rather widely. The present communication, however, is confined to the description of material, discussion of relationships being reserved for a future presentation. The Fort Union material here described, therefore, is of especial interest, since it extends considerably our knowledge of this important group of creodonts.

In preparing this paper, I have had for comparison and study, in addition to the Fort Union material in the U. S. National Museum collection, all the better *Clænodon* specimens recently secured from the Torrejon of New Mexico by the American Museum field parties, and the types described by Cope. I wish here to express my appreciation for the loan of this material so generously granted by Professor H. F. Osborn and Dr. W. D. Matthew, and I am especially indebted to them for the use of four drawings, here published for the first time, illustrating, in

¹1892, Proc. Acad. Nat. Sci. Phila., pp. 291-323.

²1882, Amer. Nat., XVI, p. 833.

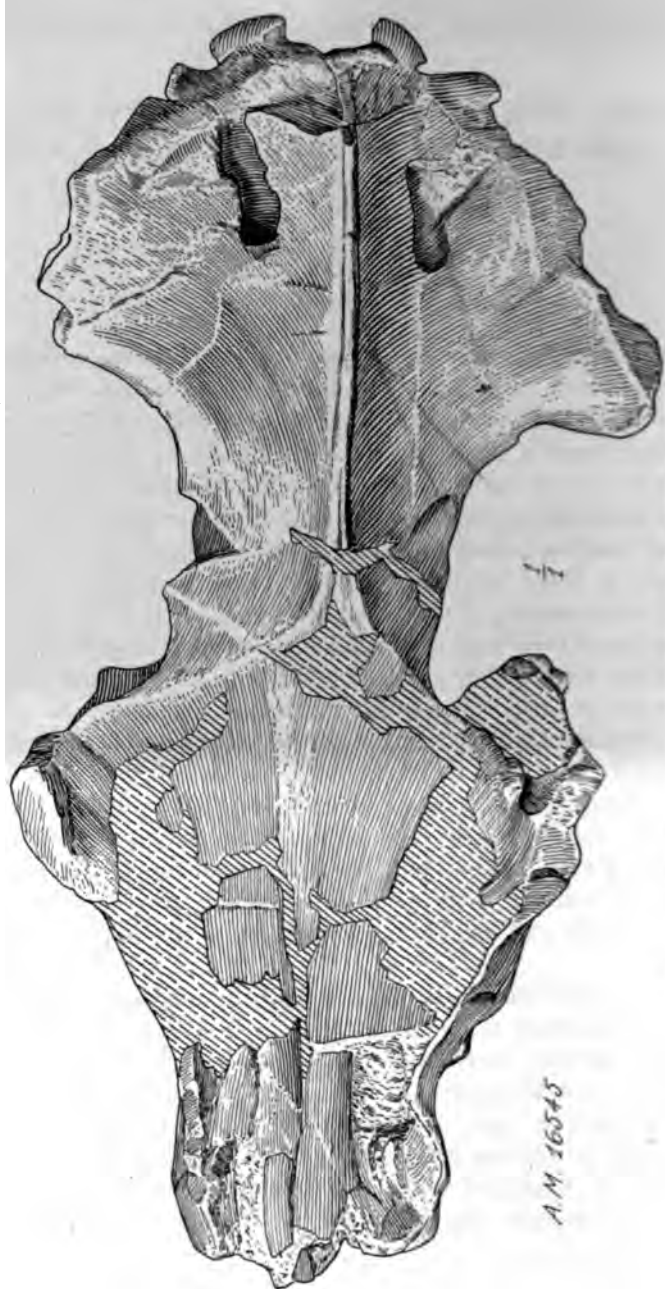


Fig. 1. *Clamdon corrugatus*. Shell, top view. No. 16543, A. M. N. H. Coll.
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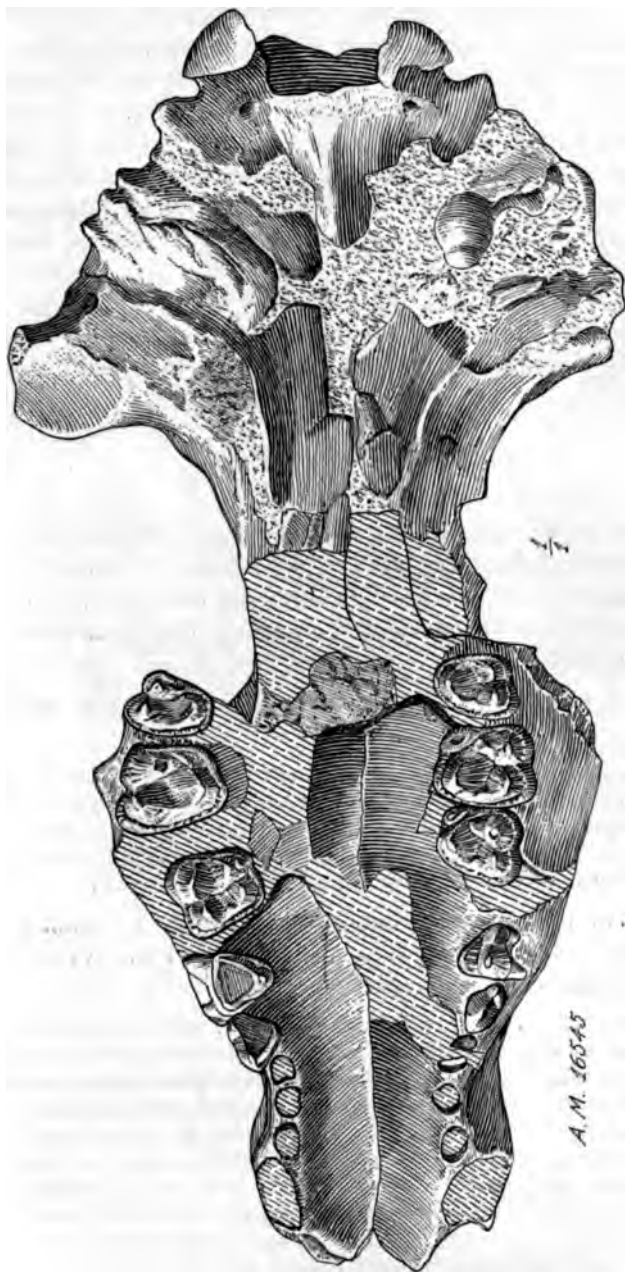


Fig. 2 *Clenodon corrugatus*. Skull, palate view. No. 16545, A. M. N. H. Coll.

part, one of their best specimens of *Clanodon corrugatus*. The drawings for illustrations have been very carefully made by Mr. Rudolph Weber.

In the National Museum collection from the Fort Union beds of Sweet Grass County, Montana, there are four species of *Clanodonts* represented. Only one of these seems referable to the genus *Clanodon* as represented by the New Mexico species. The others seemingly represent a distinct group and are therefore here described under a new generic name.

The above-mentioned, more recently acquired Torrejon material in the American Museum collection permits a better, or at least somewhat fuller, definition of the genus *Clanodon* than has hitherto been given.

CLANODON Scott

Type.—*Clanodon ferox* (Cope).

In defining this genus Scott¹ found difficulty, owing to the fragmentary condition of the material then known, in separating it from the European genus *Arctocyon*, the only important difference noted being the less completely quadritubercular character of the upper molars in the American genus.

In 1901, using somewhat better material, Matthew more clearly defined the genus *Clanodon* as follows:²

Upper premolars moderately reduced, the first one-rooted, second two-rooted, third and fourth three-rooted with high trihedral protocone [=paracone of molars] and weak cingular cusps at the bases of the three solid angles. Upper molars with three low subequal cusps, strong metaconule, somewhat weaker hypocone and a very small paraconule. Metaconule weak and hypocone absent on m^3 .

By aid of the more or less important characters presented in the fine specimen of *C. corrugatus* here figured (see Figs. 1 and 2) this definition may be still farther expanded as follows:

Dental formula, $i?$, $c\frac{1}{1}$, $p\frac{1}{1}$, $m\frac{3}{3}$; skull creodont in general type, that is, cranium elongate, brain small, sagittal crest high, canines large, and zygomatic arches heavy; lower jaw deep with lower border of ramus considerably and evenly curved antero-posteriorly; upper premolars moderately reduced, with short diastema behind p ; first and second upper molars subquadrate with three low subequal cusps, and small but well-defined hypocopes; m^3 not greatly diminished in size, but with metacone slightly reduced and with no hypocone; carpus with scapho-centrale and lunar separate but progressing toward the development of a fused scapho-lunar typical of

¹1892, Proc. Acad. Nat. Sci. Phila., p. 289.

²1901, Bull. Amer. Mus. Nat. Hist., XIV, p. 13.

the true carnivores; proximal, or radial, facets of scaphoid and lunar subequal; tarsal elements relatively short and broad; astragalus articulating and slightly but distinctly interlocking with cuboid; navicular facet of cuboid not entirely continuous with those of the astragalus and ectocuneiform; femur with third trochanter but little below level of lesser trochanter in position; digit IV, at least of the hind foot, longest of series. (Some of these characters, the last two especially, are possibly common to all species of the family.)

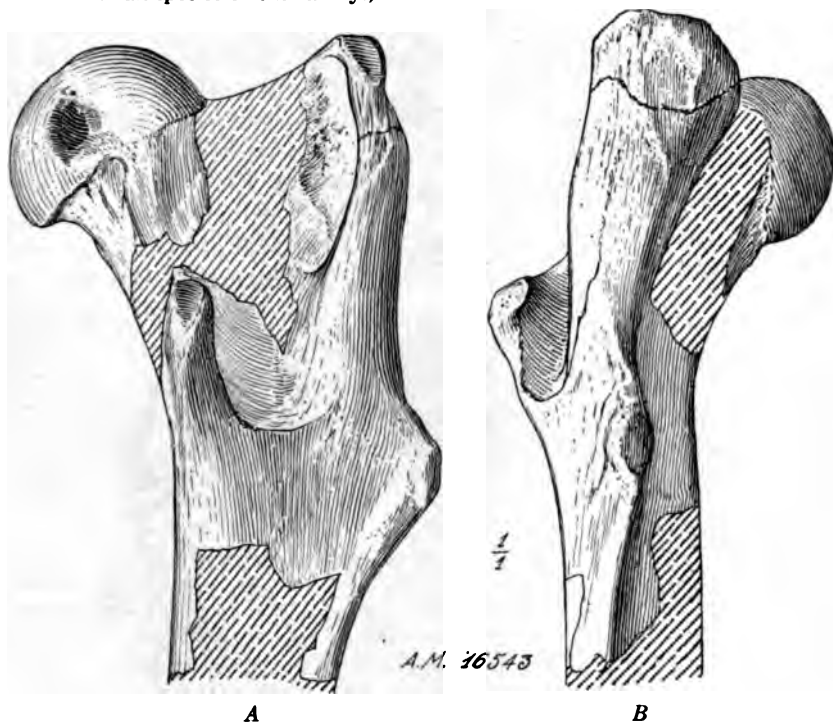


Fig. 3. *Clenodon corrugatus*. Proximal end of right femur. A, posterior view; B, outer side view. No. 16543, A. M. N. H. Coll.

Clenodon cf. ferox Cope.

I provisionally refer to the Torrejon species (*C. ferox*), the specimen above mentioned from the Montana locality. It consists of a portion of a right lower jaw carrying a single molar, m_2 (U. S. Nat. Mus. No. 6156). This molar differs from the corresponding tooth in specimens from the New Mexico locality, with which I have compared it, in the following minor details: talonid slightly narrower than trigonid (the reverse in the Torrejon specimen), enamel wrinkling more pronounced within the basin of the talonid, less pronounced on the outer walls of the



Fig. 4. *Clanodon corrugatus*. Right hind foot, with bones in position as found in original matrix. No. 16543, A. M. N. H. Coll.

protoconid and hypoconid; paraconid and entoconid more depressed, the former being extremely vestigial. The tooth agrees in size and general appearance with its homologue of the Torrejon specimens, and the slight differences here noted, with the possible exception of the narrower proportions of the talonid, may be found to come readily within the range of individual variation when several specimens can be compared. It is possible, however, that more complete material from the Montana locality may establish the possibility that the present specimen belongs to a new species.

The specimen here described came from near the top of the upper member of the Fort Union, designated by Stone and Calvert¹ as the "massive gray Ft. Union sandstone" section overlying the "Lebo andesitic member of the Ft. Union formation." It therefore represents a horizon about 5000 feet above the base of the Fort Union and 3000 feet or more above the stratum from which came the other material here described.

NEOCLÆNODON, new genus

Type.—*Neoclænodon montanensis*, new species.

Definition of Genus.—Dental formula as in *Clænodon*; cranial portion of skull relatively long and deep; interorbital space apparently much narrower, and post-orbital constriction longer and more slender than in *Clænodon*: anterior premolars, upper and lower, much reduced; in upper jaw distinct diastemæ behind p^1 , and between p^2 and p^3 ; the first premolar, above and below, lies closely appressed to the canine; hypocone in m^1 and m^2 rudimentary, wanting in m^3 ; m^3 much reduced, suboval in outline with relatively small metacone. Carpus and tarsus much as in *Clænodon*, but differing in minor details as follows: lunar relatively small, radial facet being not more than two-thirds as wide as that of the scaphoid; fibular facet of the calcaneum much reduced or wanting; neck and head of astragalus relatively thin and broad; cuboid with facet for the astragalus, navicular and ectocuneiform arranged horizontally, nearly parallel and merging into each other. (See Pl. XXVIII, figs. 1 and 1a.)

Neoclænodon montanensis, new species

Type.—No. 8362, U. S. National Museum Coll. Parts of a skeleton, including considerable portions of the skull and lower jaws carrying most of the dentition, several bones of the fore and hind feet, portions of a femur, a radius, several fragments of ribs, and a few vertebrae. Collected by Mr. A. C. Silberling.

Locality.—"Gidley Quarry," Sec. 23, T5N, R15E. Sweet Grass County, Montana.

¹1910, *Economic Geology*, V, No. 6, p. 752.

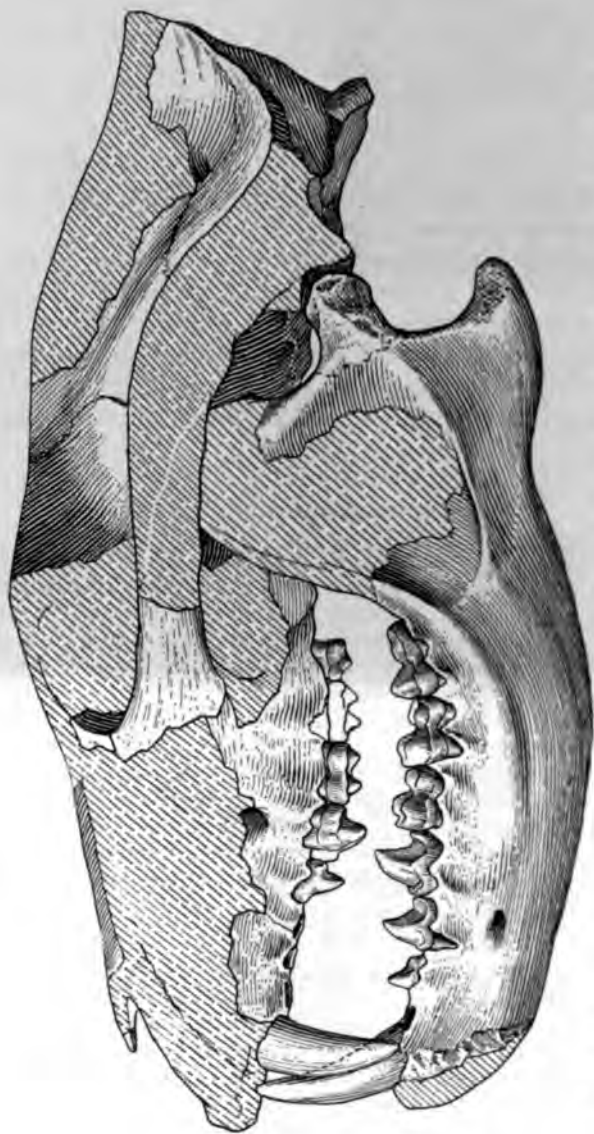


Fig. 5. *Neodenodon montanensis*. Skull and lower jaw, view of left side. 1/4. Type specimen, No. 8362, U. S. N. Mus. Coll.

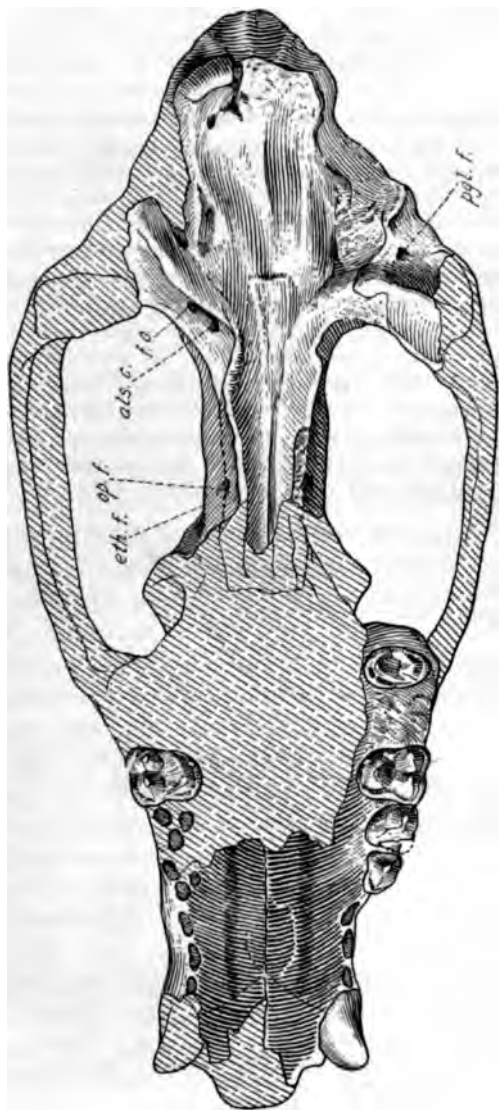


Fig. 6. *Neotamias montanensis*. Skull, palate view. 31. Type specimen, No. 8362, U. S. N. Mus. Coll.

Horizon.—Upper portion of the Lebo andesitic member of the Fort Union, about 30 feet below the massive sandstone section of Stone and Calvert (*loc. cit.*, p. 547) and nearly 2000 feet above the base of the Fort Union.

This species is further represented in the collection by a second specimen (No. 6159) consisting of portions of both sides of a lower jaw, each carrying the second true molar.

Description.—About one-fifth smaller than *Clanodon ferox* and *C. Corrugatus*, slightly larger than *C. protoconioides* (Cope); face relatively short, rostrum deep; brain-case very small and elongate; postorbital constriction long and slender; posterior root of zygoma depressed below the basioccipital plane (probably a primitive character and of much more than species significance), giving a decidedly arched contour to the main portion of the skull viewed from the side; anterior border of orbit directly above anterior boundary of m^2 ; infraorbital foramen directly above middle of p^3 ; the large, moderately recurved, slightly compressed canines with root-portion much swollen and in contour difficultly distinguishable from the crown into which it merges without any deviation in outline; 1st premolar, upper and lower, single-rooted, relatively large (compared with p^2) and closely appressed to the canine; p^3 and p^4 triangular, three-rooted, p^4 with incipient protocone; upper m^2 suboval in outline, much reduced with low external cusps, the metacone relatively small and inwardly placed; p_3 and p_4 with small, narrow, single-cusped beels; lower jaw relatively thin and deep with the lower border of its anterior half but slightly curved.

MEASUREMENTS

Length of upper dental series, c to m^3 (estimated).....	63.1 mm.
Length p^3 to m^3	37.6 mm.
Length p^4 (estimated).....	7.3 mm.
Width p^4	7.5 mm.
Length m^1	9.4 mm.
Width m^1	10.0 mm.
Length m^2	5.5 mm.
Width m^2	9.3 mm.
Length of lower dental series c to m_3	65.0 mm.
Length m_1 to m_3	28.5 mm.
Length m_2	9.4 mm.
Width m_2	7.5 mm.
Length m_3	9.9 mm.
Width m_3	6.5 mm.
Depth of jaw at m_2	21.5 mm.
Depth of jaw at p_2	18.2 mm.
Total basal length of skull (estimated).....	155.0 mm.
Width of skull across orbital region, including zygomas (estimated).....	65.0 mm.

Even in our present knowledge of the clænodont group it is difficult to determine the limits of individual variation and species characters; and it is quite probable that some of those here stated have a much wider significance than I have here given them, while others may have less

importance. This statement applies equally to the following more detailed description of the type specimen.

The skull is not greatly specialized but shows the following characteristic modifications: glenoid fossæ situated forward in position as in the *Miacidæ*; sagittal crest high and prominent (primitively correlated with the small brain, and the large canines with which were doubtless associated heavy temporal muscles), occipital crest but little expanded; nasals long, slightly widening forward and overlapped by a considerable portion of the maxillary in the normal creodont-carnivore way; posterior root of zygoma prominent with roof of glenoid fossæ depressed below the level of basisphenoid plane as in the bears; relative position and arrangement of cranial foramina, also as in the *Ursidæ*, that is, the optic foramen is placed well forward of the anterior sphenoidal fissure which lies close to the foramen rotundum, with the anterior opening of the alisphenoid canal just below them; the ethmoid foramen lies nearly above the optic foramen and well behind the postorbital process (an important character, as the position of this foramen marks the posterior border of the cribriform plate of the ethmoid); foramen ovale, and posterior opening of alisphenoid canal connected by a groove or depression which is separated from the basisphenoid plate by a prominent ridge of the alisphenoid.

The foot elements preserved show the following special features: the carpus, as represented by the fused scapho-centrale and the lunar, (see Fig. 7) may be considered, in a sense, generalized in type, although these elements were apparently approaching the stage of fusion to form a scapho-lunar as in modern carnivores, the lunar being closely interlocked with the fused scapho-centrale, and probably already functioning as the typical scapho-lunar. These elements differ from the corresponding ones in *Clenodon*, as already stated, in that the lunar is relatively smaller, the radial facet being about two-thirds the width of that on the scaphoid and less than one-half the total width of the latter. In both elements the vertical depth of the anterior face is relatively less. Compared with the scapho-lunar of *Ursus* they are, taken together, relatively broader transversely and less deep, and the scaphoid differs in the greater relative size of the facets for the trapezoid and trapezium, and in the more lateral position of the trapezium facet. A transition to the scapho-lunar of the ursid type from these elements may well have been effected, however, through a shifting or extension backward of the inner portion



Fig. 7. *Neoclenodon montanensis*. Lunar and scapho-centrale, anterior view. $\frac{1}{4}$. Type specimen, No. 8362, U. S. N. Mus. Coll.

of the scaphoid to bring the trapezium facet more directly behind that of the trapezoid, and by completing the fusion of the lunar with the scapho-centrale. This might readily have been accomplished in passing from the more primitively bent position of the fore limb, as in *Neoclænodon*, to the more straightened position assumed by the modern bears, the observable differences being largely due to the greater angulation of the wrist in the former.

The tarsal elements also differ slightly from those of *Clænodon* (see Fig. 8), but present the same general characteristics. The thickness of the calcaneum is much reduced and the pedestal carrying the cuboidal facet is the neck of the astragalus is somewhat narrower than in *Clænodon*; the head of the astragalus is relatively wide and flat, its breadth about equal to that of the tibial facet, wider than the tibial facet in *Clænodon*. The neck of the astragalus is set directly below the inner trochanter ridge. Its head which articulates with the cuboid is regularly convex and much broader than deep. The articular facet for the malleolus is very shallow and evenly concave; the minor calcaneal facet is broadly convex and nearly continuous with that of the navicular. The cuboid has a well-marked facet for the astragalus and in general is like that of *Clænodon*. In both, the calcaneum facet is broad, slightly convex (somewhat broader in *Clænodon* than in *Neoclænodon*); viewed from in front, it slopes rather steeply forward, downward and outward. In this, as in most other features, it at once suggests the cuboid of *Ursus*, the latter differing from that of the clænodonts only in its slightly broader proportions and in the more forward position of the astragalar facet which cuts off the sharp angle, or protuberance, observed at this point in the latter.

***Neoclænodon silberlingi*, new species**

Type.—No. 8363, U. S. National Museum Coll.

Portion of right maxillary carrying cheek teeth, p^3 to m^3 , and alveoli for canine and premolars 1 and 2. Same locality and horizon as *N. montanensis*. Collected by J. W. Gidley.



Fig. 8. *Neoclænodon montanensis*. Right hind foot. A, part of tarsus; B, digits III and IV. H. Type specimen, No. 8362, U. S. N. Mus. Coll.

Description.—A slightly smaller species than *N. montanensis* from which it differs as follows: cusps of all the molars seemingly¹ more depressed; m^3 and pm^3 's^{1,4} somewhat less reduced although more reduced than in *Cladodon*: all the cheek teeth, except p^3 , relatively wider; distance between p^3 and the canine relatively greater indicating a somewhat more elongate face; infraorbital foramen approaching nearer to the alveolar border above p^3 .

This species in size approximates *C. protogonioides* (Cope) but is apparently clearly distinguishable from the Puerco species by the much greater reduction and more oval contour of m^3 , and in the relatively wider proportion of all the cheek teeth.

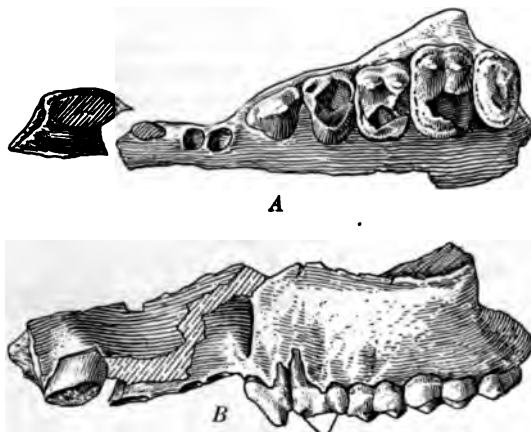


FIG. 9. *Neocladodon silberlingi*. Portion of left maxillary. A, crown view; B, outer side view. ♂. Type specimen No. 8363, U. S. N. Mus. Coll.

MEASUREMENTS OF *N. silberlingi*

C to m^3	60.0 mm.
p^3 to m^3	34.5 mm.
m^1 to m^3	21.4 mm.
m^1 length.....	7.0 mm.
m^1 width.....	8.8 mm.
m^2 length.....	7.4 mm.
m^2 width.....	11.5 mm.
m^3 length.....	5.0 mm.
m^3 width.....	9.0 mm.
Distance between p^3 and p^3	5.0 mm.
Height of p^3 (outside).....	5.5 mm.
Length of canine alveolus.....	7.5 mm.

¹Though found in its original bed, the enamel of all the teeth is considerably damaged through weathering or leaching by surface water which had reached the specimen through cracks in the matrix.

MEASUREMENTS OF *C. protogonioides*

After Cope:

Length m^2	8.0 mm.
Width m^2	10.0 mm.
Length m^3	7.0 mm.
Width m^3	9.0 mm.

(?) *Neoclænodon latidens*, new species

Type.—No. 8388, U. S. National Museum Coll.

Right lower jaw carrying two molars, m_2 and m_3 , and fragment of m_1 . Same locality and horizon as *N. montanensis*. Collected by J. W. Gidley.

Description.—Size approximately that of *N. montanensis*, but with decidedly wider molars; jaw relatively longer, much straighter, and more slender. Since the upper dentition of *N. latidens* and the lower dentition of *N. silberlingi* are not known, these species can not now be compared, but the difference in size seems sufficient to distinguish them.

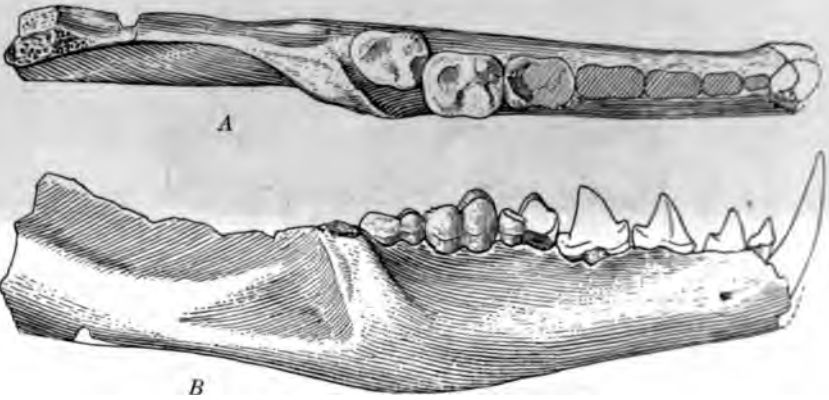


Fig. 10. *Neoclænodon latidens*. Portion of right ramus of lower jaw. A, crown view; B, outer side view. $\frac{1}{4}$. Type specimen, No. 8388, U. S. N. Mus. Coll.

MEASUREMENTS

Length of m_2	9.7 mm.
Width of m_2	8.4 mm.
Length m_3	9.6 mm.
Width of m_3	7.6 mm.
Depth of jaw at m_2	16.0 mm.

Unfortunately, as in the type of *N. silberlingi*, the enamel of the molars has been considerably damaged through weathering or leaching by surface water, which somewhat obscures the detailed structure.

The generic reference is provisional, since certain features, as the straight and more slender proportions of the jaw and relatively greater width of the lower molars, so sharply distinguish *N. latidens* from all other species of this genus or of *Clænodon*. They suggest that its affinity to the group to which I here assign it may be, after all, not very close. More complete and better preserved material may, therefore, necessitate placing it in a distinct genus.

PLATE XXVIII

(Lengths about $\frac{2}{3}$)

Figs. 1 and 1a. *Neoclænodon* *ensis*. Right cuboid of type specimen viewed from proximal and inner surfaces, respectively. No. 8362, U. S. N. Mus. Coll.

Figs. 2 and 2a. *Clænodon* *ensis*. Right cuboid view from proximal and inner faces, respectively. No. 16, U. S. N. H. Coll.

Figs. 3 and 3a. *Euarctos* sp. Right cuboid of specimen from the Cumberland Cave (Pleistocene), viewed from proximal and inner surfaces, respectively. No. 8179, U. S. N. Mus. Coll.

These figures are intended to illustrate comparative differences and likeness of the cuboid, first between the two genera of Clænodonts, and second between Clænodonts and bears. That representing the bears was selected as being extreme the relative expansion of its distal end.



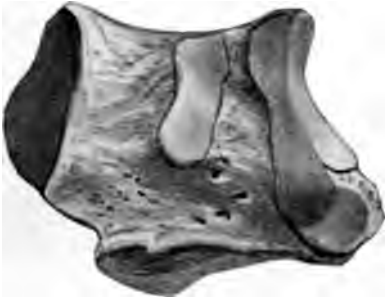
1



1a



2



2a



3



3a

Article XV.—NEW TITANOTHERES OF THE HUERFANO

BY HENRY FAIRFIELD OSBORN

Renewed exploration of the Huerfano Basin of Colorado by the American Museum party under Mr. Walter Granger assisted by Mr. George Olsen, with the coöperation of Mr. R. C. Hills of Denver, during the season of 1918, has resulted in very important additions to our knowledge of this Lower Eocene fauna and of its relations to the little-known fauna of the base of the Bridger formation, Wyoming, known as Bridger A.

The geologic results will be fully reported by Mr. Hills. The general palæontologic results will be reported in detail by Mr. Granger. In the meantime, immediate description of the new titanotheres seems desirable.

Besides the collections referred to in the following description of the Huerfano fauna, there is a small collection in the United States National Museum made by Mr. J. Milligan for Mr. Hills about 1885. It includes upper molar teeth referable to the titanotheres.

GEOLOGIC RELATIONS

The Huerfano proves to be about 3500 feet in thickness. Its faunistic subdivision, as already described by Osborn and Wortman,¹ is in the two life zones:

UPPER HUERFANO, Huerfano B, fauna of surviving *Eotitanops*, of *Palæosyops* (*Limnohyops*) *fontinalis*, of *Eometarhinus*, of *Trogosus*, etc., which now appears to be of similar age to the fauna of the base of the lower Bridger, namely, Bridger A, *Trogosus*, *P. fontinalis* zone.

LOWER HUERFANO, Huerfano A, fauna of abundant *Lambdotherium* and rare *Eotitanops*, similar to that of the Lost Cabin formation, upper Wind River levels, Wind River B, *Lambdotherium-Eotitanops* zone.

NEW SECTION OF THE HUERFANO BEDS

The accompanying section (Fig. 1), prepared by Mr. Granger from his recent exploration, considerably alters our previous estimates both of the thickness of the Huerfano formation, which now rises to 3500 feet, and the relations of the respective Wind River and Bridger faunæ. The

¹Osborn, H. F., 1897, Bull. Amer. Mus. Nat. Hist., IX, pp. 247-258.

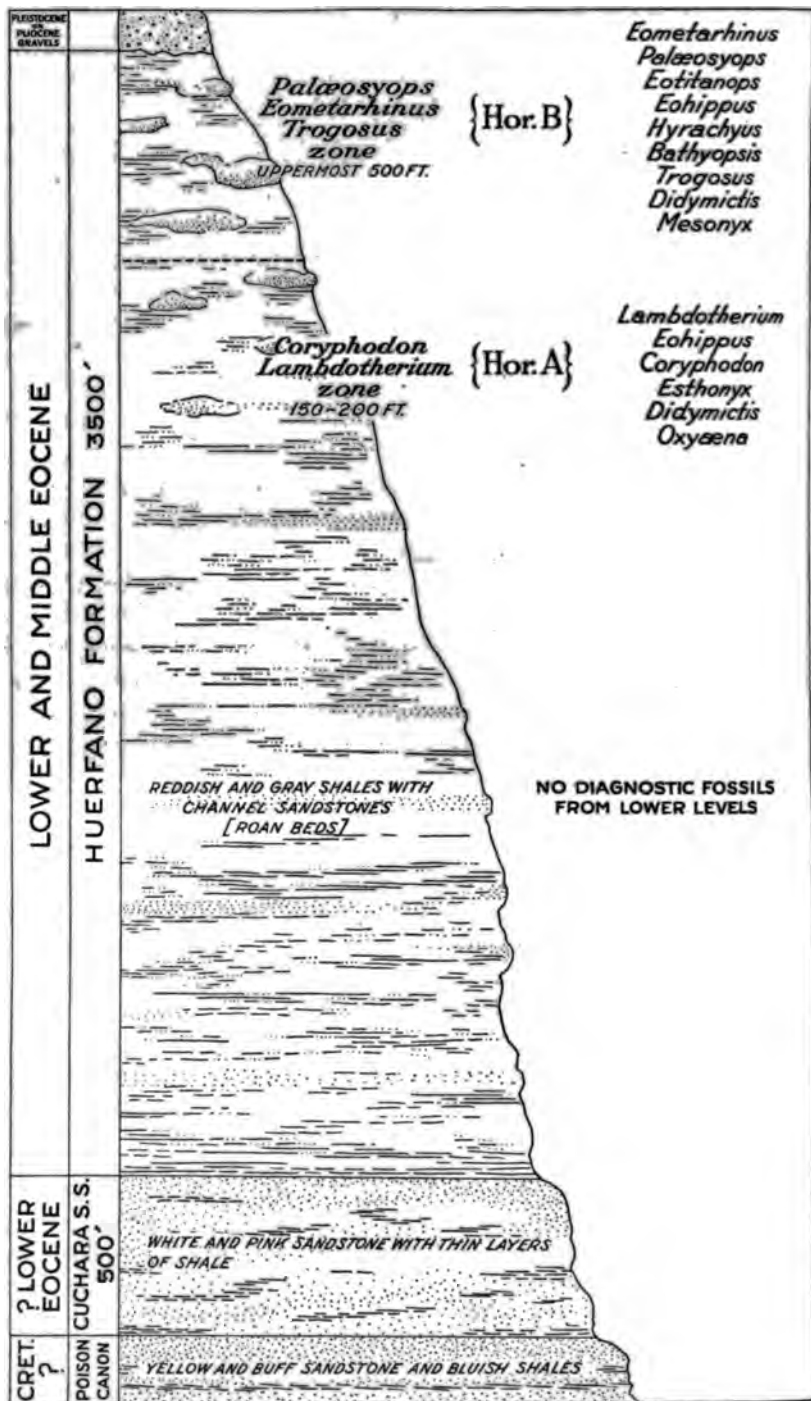


Fig. 1. New section of the Huerfano formation from our present knowledge of the faunal levels. After Granger, 1919.

Wind River *Lambdaotherium* zone, Huerfano A, proves to be between 150 and 200 feet in thickness and is located at the bottom of the upper third of this formation, although the exact level has not been ascertained. The Bridger *Palæosyops fontinalis*, *Eometarhinus*, *Trogosus* zone occupies the uppermost 500 feet. This section corresponds with the line drawn from the western edge of the formation, near the mouth of Poison Cañon, eastward to Gardner, along the Huerfano-Muddy Divide, thence south-east to the Cuchara outcrop on South Oak Creek.

NEW PALEONTOLOGIC RESULTS

The chief new results are as follows: (1) The discovery in Huerfano B of six specimens which cannot be separated specifically, or by measurement, from the type of *Palæosyops* (*Limnohyops*) *fontinalis* Cope, the only titanotheres certainly known to occur in Bridger A. (2) The correlation of Huerfano B with Bridger A is further sustained by the presence of *Eometarhinus huerfanensis*, an ancient species which carries the *Metarhinus-Mesatirhinus* group of titanotheres, hitherto known only in the upper Bridger, back to the base of the Bridger, a discovery of great phyletic interest. (3) At the same time, the correlation of Huerfano A with Wind River B is strengthened by the presence of two known species of *Lambdaotherium* and a third new one, all of which occur in both formations. (4) The discovery in Huerfano B of two diminutive known species of titanotheres referred to the genus *Eotitanops*, namely, *E. gregoryi*, *E. brownianus*, and of the new species, *E. minimus*, appears to indicate the survival of a dwarfed group. *E. minimus* is a pygmy compared with the contemporary *Eometarhinus huerfanensis* and with the still larger *Palæosyops fontinalis*.

The conspectus of these results in titanotheres evolution appears as follows:

I	II	III	IV
Wind River B	Lower Huerfano	Upper Huerfano	Lower Bridger
(Lost Cabin)	(Huerfano A)	(Huerfano B)	(Bridger A)
<i>Lambdaotherium popoagicum</i>	* (?)		
<i>Lambdaotherium priscum</i>	*		
<i>Lambdaotherium progressum</i>	*		
<i>Lambdaotherium magnum</i>	*		
<i>Eotitanops brownianus</i>		*	
<i>Eotitanops gregoryi</i>		*	
		<i>Eotitanops minimus</i>	
		<i>Eometarhinus huerfanensis</i>	
		<i>Palæosyops</i> (<i>Limnohyops</i>)	
		<i>fontinalis</i>	*

FOUR SPECIES OF *LAMBDOOTHERIUM* FROM THE LOWER HUERFANO, *LAMBDOOTHERIUM* ZONE

In 1897 a specimen of *Lambdaotherium* was discovered in the lower Huerfano by Wortman and provisionally identified as *L. popoagicum*, at that time the unique species of the Wind River. The discovery of three other specific stages in the evolution of this genus, common to Wind River B and Huerfano A, may be described in the order of evolution.

Lambdaotherium priscum Osborn

This Wind River species is identified in Huerfano A by Amer. Mus. 17526, a fine pair of jaws from Garcia Cañon. The specific character of p_3 , *without trace of metaconid*, is clearly shown in Fig. 3. This species is represented by another jaw, with teeth of the same size, Amer. Mus. 17528, in which p_3 , *also without metaconid*, is in a slightly more advanced stage of evolution, the talonid being broader.

This species is also doubtfully represented by the imperfect specimen of upper teeth referred to *L. popoagicum* by Wortman, Amer. Mus. 2688, as well as by the newly found specimen, Amer. Mus. 17529, of approximately the same size.¹ In this specimen, Amer. Mus. 17529, found three miles east of Gardner Butte, the isolated upper teeth of two sides, including p^3 - m^3 , show the following characters: (1) molars slightly smaller than in the referred specimen of *L. progressum*; (2) conules and cingulum not so well developed; (3) measurements slightly inferior to those of the type of *L. popoagicum*.



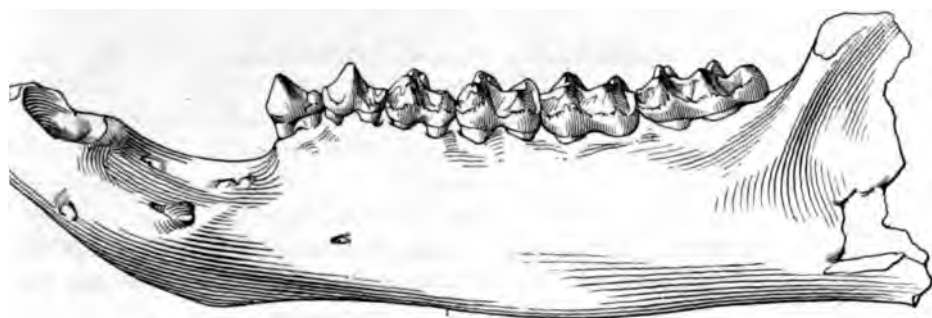
A.M. 17530 $\frac{1}{7}$ *L. progressum* ref.

Fig. 2. Upper teeth of *Lambdaotherium progressum*, referred specimen from Huerfano A.

Lambdaotherium progressum Osborn

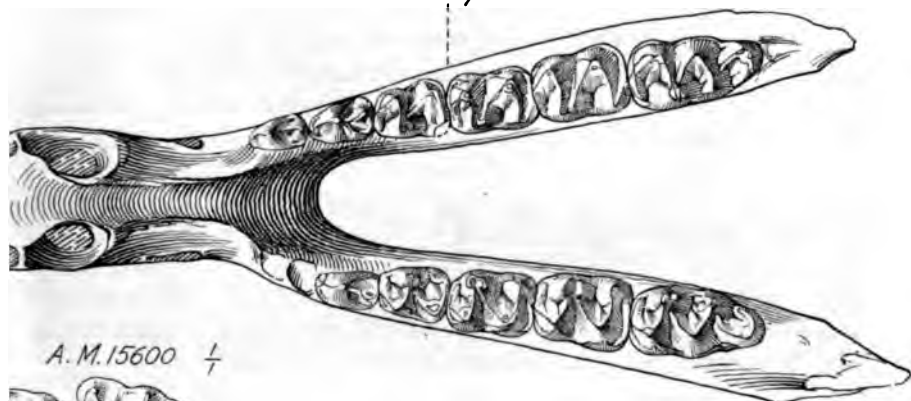
This Wind River type is distinguished by p_3 *with strong metaconid*, i.e., submolariform. A series of molar teeth, p^3 - m^3 , represented in Fig. 2.

¹The types of *L. popoagicum* and *L. priscum* are both lower jaws from the Wind River; since there are two lower jaws from the Huerfano positively referable to *L. priscum* and none referable to *L. popoagicum* it seems best to assign these two sets of upper teeth to *L. priscum* also.



A.M. 17526 $\frac{1}{7}$

L. priscum ref.

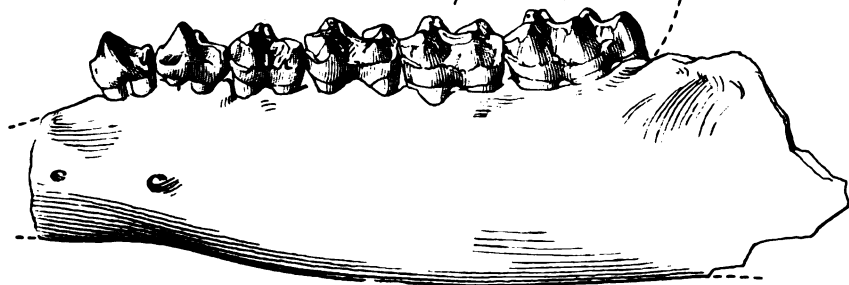


A.M. 15600 $\frac{1}{7}$

L. priscum ref.



A.M. 17527 (p^3 rev) $\frac{1}{7}$



L. magnum type

g. 3. No. 17526. Lower jaw of *Lambdotherium priscum*, referred specimen from Huerfano A. Outside and views.

o 17527. Outer view of type jaw of *Lambdotherium magnum*, Huerfano A.

o 15600. First and second upper molars of *Lambdotherium magnum*, referred specimen from the Wind River m of the Bighorn Basin, Wyoming.

from the lowest level of the lower Huerfano, is referred to *L. progressum* on the following grounds: (1) the upper teeth fit pretty well those of the type of *L. progressum* from the Wind River; (2) the parastyle is especially prominent at the antero-external angle of m^2 , m^3 ; (3) m^3 with prominent hypocone and cingular hypostyle; (4) outer cusps of premolars approximated, conules prominent; (5) cingulum strong on p^4 and m^3 .

With these specimens, association doubtful, were found the calcaneum, portion of a tibia, and a proximal phalanx.

***L. magnum*, new species**

Exceeding in size the type jaw, from the lower Huerfano, containing all sides, represented in Fig. 3. The measurements of the type of *L. magnum* are .067. (2) P_3 has a rudimentary metaconid. The same stage of evolution as in the type is a referred specimen, Amer. Mus. 15600, from the lower Huerfano. These referred specimens, m^1 , m^2 , etc., may be regarded as a paratype, as represented in Fig. 3.

MEASUREMENTS OF INFERIOR TEETH P_2 - M_3 AND SUPERIOR TEETH M^1 - M^2

					P_2 - M_3
Huerfano A	Ref.	<i>L. priscum</i>	Amer. Mus. 17526	.....	.067
Wind River B	Type	<i>L. popoagicum</i>	" " 4863	.....	.069
" " B	"	<i>L. progressum</i>	" " 14917	.....	.071e
Huerfano A	"	<i>L. magnum</i>	" " 17527	.....	.074
					M^1 - M^2
Huerfano A	Ref.	<i>L. priscum</i>	Amer. Mus. 17529	.....	.0215
" A	"	<i>L. " "</i>	" " 2688	.....	.0225
Wind River B	"	<i>L. popoagicum</i>	" " 14902	.....	.0250
Huerfano A	"	<i>L. progressum</i>	" " 17530	.....	.0235
Wind River B	"	<i>L. magnum</i>	" " 15600	.....	.0275

These measurements show that there is not a great range in size between the smaller and the larger animals referred to this genus.

THREE SPECIES OF DWARF *EOTITANOPS* FROM THE UPPER
HUERFANO, *TROGOSUS* ZONE

The true Wind River beds contain (1) the larger titanotheres *Eotitanops borealis* (Cope), *E. princeps* Osborn and *E. major* Osborn; (2) also two diminutive types of titanotheres, *E. brownianus* (Cope) and

E. gregoryi Osborn, the latter, up to the present time, the smallest true titanotheres known. It is supposed that the larger forms (1) are ancestral to the Bridger Palæosyopinae (*Palæosyops*, *Limnohyops*); the smaller forms (2) appear to be represented, in the Huerfano, in survivals of three stages of diminishing size, as follows.

***Eotitanops brownianus* (Cope)**

This diminutive titanotheres is represented by a single referred specimen, Amer. Mus. 17441, m_3 of the right side, from Apodock Gulch, two miles southeast of Gardner and close to the border line between the upper and lower Huerfano. This referred tooth (Fig. 4, C) is precise in size with the corresponding tooth (measured by the root) of the *E. brownianus* type from the Wind River; no other comparison can be made.

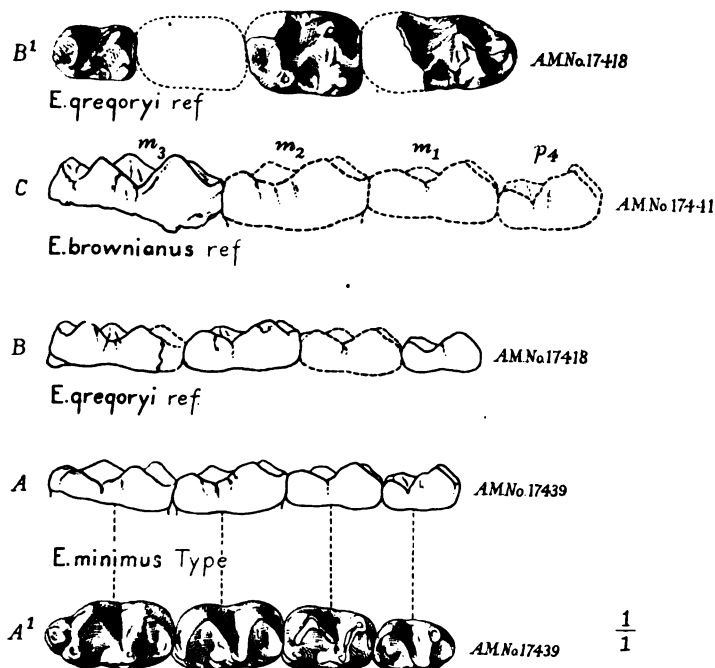


Fig. 4. Diminutive species of *Eotitanops* belonging to Huerfano B.

A, A¹, *E. minimus*, type.

B, B¹, *E. gregoryi*, referred specimen.

C, *E. brownianus*, referred specimen.

The hypoconulid of the m_3 in the type of *E. minimus* is abnormal.

***Eotitanops gregoryi* Osborn**

Of the same size as the type of *E. gregoryi* from the Wind River are the referred isolated teeth, p_4 , m_{2-3} , from the upper Huerfano, two miles north of Gardner, Amer. Mus. 17418 (Fig. 4, B, B¹).

***Eotitanops minimus*, new species**

In reference to the fact that it is the smallest true tianothere known, these type lower molar teeth, p_4 - m_3 , Amer. Mus. 17439 (Fig. 4, A, A¹), from the lower level of the upper horizon of the Huerfano formation, Colorado, Huerfano B, are assigned a new specific name on the following grounds: (1) the measurement of p_4 - m_3 (.053) is much less than that (.058) of the corresponding teeth in *E. gregoryi*; (2) the other characters are so similar to those of *E. gregoryi* as to suggest that this is a related form.

The accompanying figures (Fig. 4, A, B, C) exhibit the dimensional proportions of the above species of *Eotitanops*. It has been found from the large number of measurements of Eocene titanotheres that no single species exhibits so great a range of size.

SPECIES OF PALÆOSYOPINÆ AND DOLICHORHININÆ FROM THE
UPPER HUERFANO, TROGOSUS ZONE

The discovery of two very distinct true titanothere phyla in the Lower Eocene confirms the theoretic separation of the titanotheres into various subfamilies as occurring in Lower Eocene time. In the Huerfano we have evidence of two subfamilies, as follows:

PALÆOSYOPINÆ	DOLICHORHININÆ
(Perhaps derived from the Eotitanopinæ)	(<i>Manteoceras</i> - <i>Melarhinus</i> - <i>Mesatirhinus</i> - <i>Dolichorhinus</i> group)
Hornless	Osseous horn rudiments at naso-frontal junction
Slender nasals	Nasals very stout, laterally decurved
Sub-brachycephalic	Mesaticephalic
More robust proportions	Smaller proportions

The first subfamily is represented by numerous specimens of *Palæosyops fontinalis* Cope; the second group is represented by the single type specimen of the new genus *Eometarhinus huerfanensis*, as described below.

***Palæosyops fontinalis* Cope**

This species is represented by the remains of six individuals from the upper Huerfano beds, as follows:

- Amer. Mus. 17411, superior dentition and portion of palate, Huerfano-Muddy Divide, two miles west of Gardner, Colorado, 414 feet below the top of the Huerfano formation.
- “ “ 17425, series of right upper grinders, p^3-m^3 , two miles north of Gardner, 400 to 500 feet below the top of the Huerfano.
- “ “ 17414, three superior molars, fragmentary, three miles north of Gardner, 400 to 500 feet below the top of the Huerfano formation.
- “ “ 17413, two upper molars and incisor, three miles north of Gardner, 400 to 500 feet below the top of the Huerfano formation.
- “ “ 17417, m^1 , p^1 and milk teeth, two miles north of Gardner, 400 to 500 feet below the top of the Huerfano formation.
- “ “ 17450, lower canine and fragment of m^3 , Huerfano-Muddy Divide, two miles west of Gardner, about 250 feet below the top of the Huerfano.

These specimens range from 250 feet to 500 feet below the top of the Huerfano formation. A finely preserved palate, Amer. Mus. 17411 (Fig. 5, A), of an aged individual, and the unworn upper teeth, Amer. Mus. 17425 (Fig. 5, D), of a young individual, afford a close comparison with the two permanent teeth of the type of *Palæosyops fontinalis* from Bridger A and are very similar both in characters and in measurement.

	Type <i>Palæosyops</i> <i>fontinalis</i> 5107 Amer. Mus. Bridger A	17425 Amer. Mus. Upper Huerfano	17411 Amer. Mus. Upper Huerfano	17414 Amer. Mus. Upper Huerfano	17413 Amer. Mus. Upper Huerfano	<i>Palæosyops</i> <i>paludosus</i> 13032 Amer. Mus. Bridger B 1
m^1-m^3	....	.083	.077	....	....	.091
p^4 a. p.	....	.0165	.0163	....	....	.018
p^4 tr.	....	.0215	.0215	....	....	.022
m^1 a. p.	.022	.023	.0225	....	.0235	.025
m^1 tr.	.026	.026	.026	....	.026e	.026
m^3 a. p.	....	.029	.027	.030	.028	.032
m^3 tr.	....	.034	.0315	.034	.0325	.034
p^1-m^3	....	.146e	.141	....	....	.160
p^1-p^4	....	.063e	.063	....	....	.071

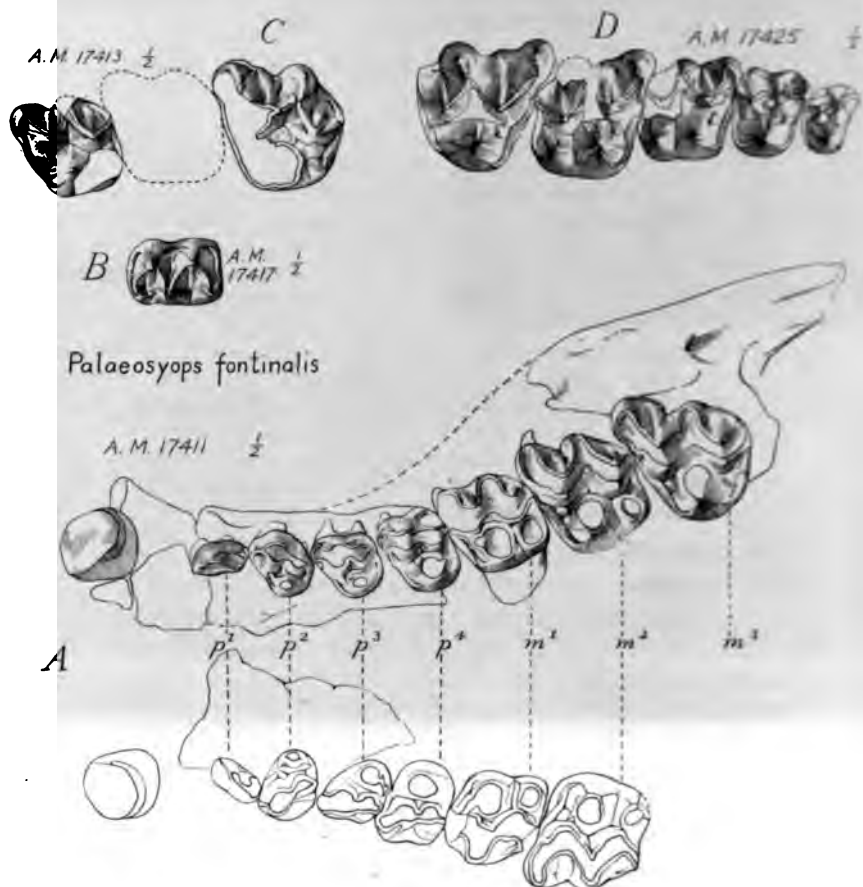
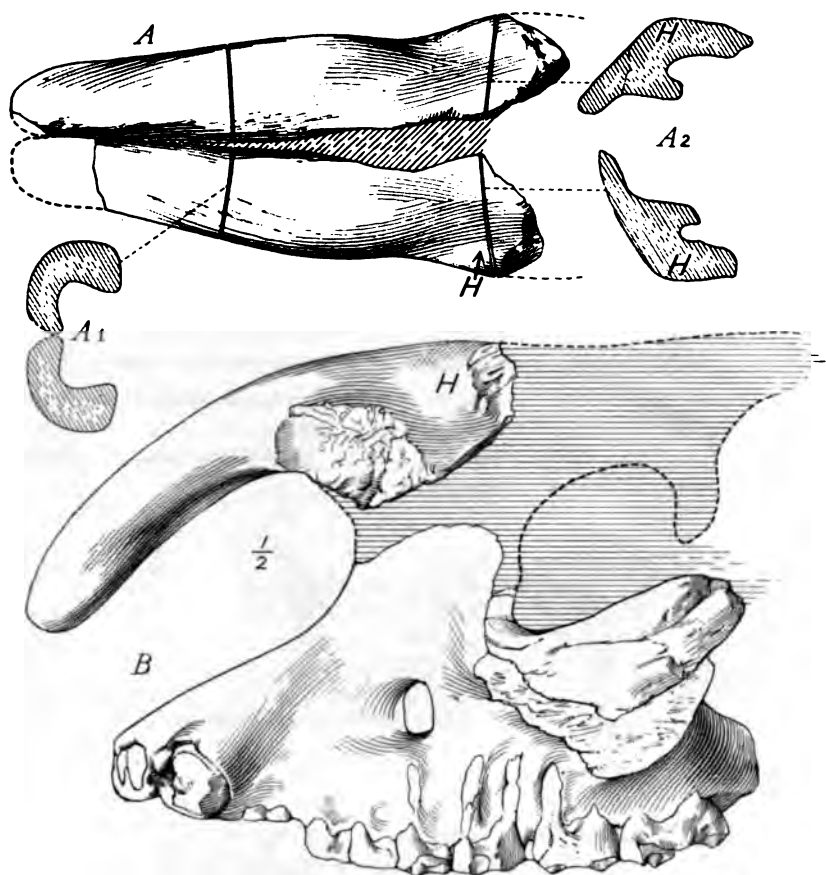


Fig. 5. A, B, C, D, referred specimens of *Palaeosyops fontinalis*. All from Huerfano B. Teeth one-half natural size.

While these teeth are practically identical in size and characters with those of the type of *P. fontinalis*, they are smaller than those of the primitive species of *P. paludosus* and *Limnohyops* from Bridger B 1 and Bridger B 2. The whole superior grinding series, p^1 - m^3 , measures .141 (No. 17411).

The distinctive specific characters of *P. fontinalis* are: (1) parastyle very prominent; (2) protoconules reduced; (3) meta- and hypocones closely compressed; (4) no trace of metaconules; (5) no hypocone on m^3 ; (6) premolars very simple; (7) restored palate of considerable



Eometarhinus huerfanensis



Fig. 6. Type skull of *Eometarhinus huerfanensis*, from Huerfano B. One-half natural size.
H, Horn rudiments in section.
*A*¹, *A*², Anterior and posterior nasal sections.

breadth, and (8) the maxillaries send back a splint on the outer side of the malars, as in typical *Palæosyops*.

Since all these six individuals from Huerfano B agree closely in size with each other and with the type of *P. fontinalis*, they establish Huerfano B and Bridger A as the *Palæosyops fontinalis* zone, distinguished by true ancestors of *Palæosyops* inferior in size to any known members of this genus in Bridger B.

***Eometarhinus huerfanensis*, new genus and species**

GEOLOGIC LEVEL.—The geologic level is 205 feet below the top of the Huerfano Formation.

TYPE LOCALITY.—Huerfano basin, Colorado.

which this type specimen was found in the Huerfano basin.

Locality, three miles west of Gardner, Colorado.

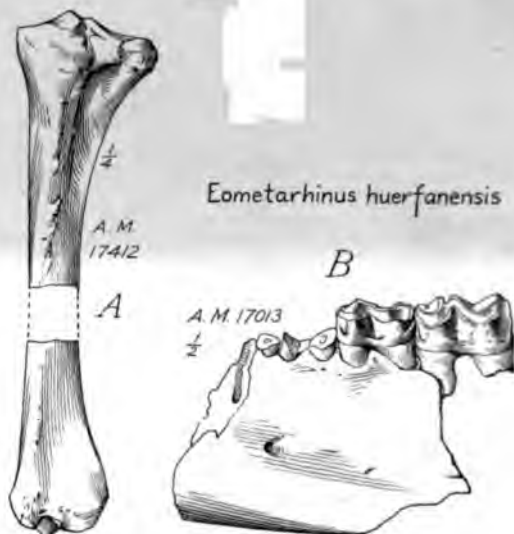


Fig. 7. *Eometarhinus huerfanensis*: A, tibia found associated with the type skull; B, fragment of the left ramus with first and second molars, referred specimen.

GENERIC CHARACTERS.—Small; ancestral to *Metarhinus*; with rudimentary fronto-nasal horn; nasals elongate; overhanging premaxillaries, decurved as in *Metarhinus*; no infraorbital shelf; characters apparently intermediate between those of the *Metarhinus* and *Mesatirhinus* phyla.

SPECIFIC CHARACTERS.—Inferior in all measurements to *M. megarhinus*. Premolars with small deuterocone. P^1-m^3 , .124; p^1-p^4 , .053; m^1-m^3 , .072.

This new genus and species from the upper Huerfano is founded upon the anterior portion of a skull (Amer. Mus. 17412) representing an animal widely distinct in all its characters from the contemporary *P. fontinalis* and more closely related to the other group of Middle Eocene titanotheres to which *Metarhinus*, *Mesatirhinus* and *Dolichorhinus* belong. The most surprising character in an animal of this geologic antiquity is the very rudimentary osseous horns at the junction of the nasals and frontals (Fig. 6, *H*), indicating the horn rudiment, a very ancient character in this phylum. Nasals are long, arched, decurved and revolute on lateral borders, thus resembling the rhinal type in the metarhine group. The malars below the orbits are prominent. There was probably no infraorbital shelf, as in *Rhadinorhinus*. The comparative measurements of *Eometarhinus*, of *Mesatirhinus megarhinus* and of the contemporary *Palæosyops fontinalis* are shown below.

	<i>Eometarhinus</i> Amer. Mus. 17412	<i>Mesatirhinus</i> <i>megarhinus</i> Amer. Mus. 12202	<i>Palæosyops</i> <i>fontinalis</i> Amer. Mus. 17425
p ¹ -m ³	.124	.147	.146e
p ² -m ³	.109	.133	.131e
m ¹ -m ³	.072	.083	.083
p ⁴ a. p.	.014	.0175	.0165
p ⁴ tr.	.018e	.023	.0215
m ¹ a. p.	.021	.025	.023
m ¹ tr.		.0265	.026
m ³ a. p.	.0255	.028	.029
m ³ tr.		.031	.034

The dental formula is normal. The premolars are small, apparently very simple in pattern. The anteroposterior diameters of the molars appear to exceed the transverse; as they are in fractured condition, no accurate measurements can be taken. Apparently a hypocone on m³.

A tibia (Fig. 7, *A*), found in association with the type skull, measures .275 (est.) in extreme length.



**Article XVI.—POLYCHÆTOUS ANNELIDS FROM PORTO RICO,
THE FLORIDA KEYS, AND BERMUDA**

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PLATES XXIX TO XXXII

This paper contains a list of the old and descriptions of nine new species of polychætous annelids found in a collection from Porto Rico, the Florida Keys, and Bermuda. Unless otherwise designated, all the specimens were collected by the expeditions sent out in 1914 and 1915 by The American Museum of Natural History and the New York Academy of Sciences in cooperation with the Government of Porto Rico. These were submitted to Prof. A. L. Treadwell for identification and through his courtesy I have used them in studying the taxonomy of the Polychætes.

Drawings such as those of gills and setæ were made with a Leitz compound microscope and camera lucida.

SYLLIDÆ

***Syllis prolifera* McIntosh**

Pionosyllis prolifera McINTOSH, 1900-07-10, p. 161.

Mangrove Island and coral reef, under coral rocks, at entrance of Montalba Bay, Porto Rico. Collected by R. W. Miner.

***Syllis gracilis* Grube**

Syllis gracilis McINTOSH, 1900-07-10, p. 203. WEBSTER, 1879, p. 17.

Rocks off Guanica Harbor, Porto Rico. Collected by R. W. Miner.

HESIONIDÆ

***Hesione proctochona* Schmarda**

Hesione proctochona SCHMARDA, 1861, Neue Wirbellose Thiere, I, part 2.

Bermuda, 1916. Collected by A. L. Treadwell.

***Podarke guanica*, new species**

Plate XXIX, Figures 1 to 4

Three specimens 12 mm. in length and 1 mm. in breadth, not including the parapodia. Body flat ventrally and convex dorsally.

The head is broader than long with angles rounded anteriorly and posteriorly (Fig. 1). There are two pairs of large, dark-brown eyes; the anterior pair situated farther apart than the posterior and provided with lenses. The dorsal margin of the head is convex medianly and anteriorly. A membranous fold stretches across this convexity and covers a part of the basal portion of the median antenna (Fig. 1).

There are five antennæ, the most centrally placed being smaller than the others. It has a short terminal joint. The median pair of antennæ are smooth; the outer pair equal to them in length but jointed in the middle.

There are twelve buccal tentacles. The first somite bears two tentacles on each side supported on a common basal joint (Fig. 1). The third somite is setigerous.

The proboscis was not completely extruded.

The parapodia are biramous. The large dorsal cirrus is borne upon a stout basal portion, and extends to the distal ends of the setæ in most cases. The neuropodium is blunt laterally with an extra conical enlargement anteriorly. The ventral cirrus is short, scarcely extending beyond the basal setæ bundle (Fig. 2).

The setæ are all compound and resemble each other in form; but the middle ones in each case are longer than the others, being more slender and having a much longer terminal joint (Figs. 3 and 4).

Rocks off Guanica Harbor, Porto Rico. Collected by A. L. Treadwell. Type in Amer. Mus. Nat. Hist.

APHRODITIDÆ

Lepidonotus variabilis Webster

Lepidonotus variabilis WEBSTER, 1879, p. 5.

Porto Rico: outer reef south of Guanica Harbor; near mouth of Guayanilla Harbor; off Guanica Harbor south of bell-buoy, 10 fathoms. Collected by R. W. Miner and R. C. Osburn.

Polynoe polytricha Schmarda

Polynoe polytricha SCHMARDA, 1861, p. 156. EHLERS, 1887, p. 49, Pl. x, figs. 9, 10; Pl. xi, fig. 1. TREADWELL, 1901, p. 186.

On mangrove roots and sandy bottom between Ensenada and Guanica, Porto Rico. Collected by R. W. Miner.

Lepidonotus notata, new species

Plate XXIX, Figures 5 to 10

• Polynoid having light-brown, smooth elytra and a row of light-brown pigment-spots on alternate somites in the mid-dorsal line.

Body 16 mm. in length and 4 mm. in breadth, including the setæ. Number of somites 26. Twelve pairs of elytra.

The head is longer than broad, being prolonged into the bases of the antennæ anteriorly. Two prominent eyes occur on the head near the lateral border. A second pair of eyes, situated at the same distance from the mid-line as the others, occur behind them and are completely hidden by the anterior edge of the first setigerous somite (Fig. 5).

Base of tentacle slightly shorter than bases of antennæ. Tentacle almost as long as palps, with filiform termination and dilation below the tip. Narrow band of brown pigment just below the enlargement; broad band of pigment farther back (Fig. 5).

Antennæ slightly more than half as long as tentacle; exact counterpart of tentacle in shape and markings.

Bases of tentacular cirri longer than those of antennæ and pigmented distally. Two cirri in each side exactly like tentacle.

Ventral cirri short and pale in color, shaped like the rest.

Cirri, tentacle, and antennæ all smooth.

Palps greater in circumference and longer than other appendages and of a yellowish brown color. Surface papillose.

Somites 2, 4, etc. (elytra-bearing somites) have, in the dorsal mid-line, a large, light-brown pigment-spot.

Parapodia large (Fig. 7), bearing ventrally bundles of stout, yellowish, toothed setæ (Fig. 8), dorsally radiate bundles of fine, smooth setæ (Fig. 9) with saw-like setæ at their base (Fig. 10).

The dorsal cirrus (somites 3-5-7-, etc.) is like the tentacle and antennæ in shape and has one pigment-band some distance below the dilation. The cirrus extends to the distal end of the dorsal setæ.

A little over a mile south of Cano Gorda Island, near Guanica Harbor. Porto Rico. Collected by R. W. Miner. Type in Amer. Mus. Nat. Hist.

The specimen described has only the first left elytron, the seventh right, and the ninth and eleventh pairs of elytra. The elytra overlap dorsally. They are light brown in color, rolling up on the outer edge apparently on account of the pressure of the large dorsal setæ bundles. The first elytron is white anteriorly and dark brown posteriorly. The elytra are devoid of marginal fringe (Fig. 6).

There is some resemblance between this form and *Lepidonotus wahlbergi* Kinberg, described by McIntosh (1885). The differences lie in the character and position of the elytra, and of the dorsal setæ. *L. wahlbergi* is a Cape form.

PHYLLODOCIDÆ

Phyllodoce papillose Ehlers

Phyllodoce papillose EHLERS, 1887, p. 140, Pl. XL, figs. 7-9.

On piles, Guanica Harbor, Porto Rico. Collected by R. W. Miner.

NEREIDÆ

Nereis acuminata Ehlers

Nereis acuminata EHLERS, 1864-1869, p. 552.

Dry Tortugas, Florida. Collected by Prof. A. L. Treadwell, 1910.

Ehlers reports this annelid from Naples. Two specimens were examined in this collection. They agree in all essential points with Ehlers' description of *N. acuminata*, especially in the arrangement of the paragnaths—an important specific character. For these reasons I have placed this Florida form in this species.

***Nereis antillensis* McIntosh**

Nereis antillensis McINTOSH, 1885, p. 224.

Dredged in red algae, entrance to Guanica Harbor, Ensenada, Porto Rico. Collected by R. W. Miner.

***Nereis arroyensis* Treadwell**

Nereis arroyensis TREADWELL, 1901, p. 193.

Reef outside Cayo Maria Langa, Porto Rico. Collected by R. W. Miner.

***Nereis diversicolor* O. F. Müller**

Nereis diversicolor McINTOSH, 1900-07-10, p. 312.

Diagnosis based on paragnaths. Rocks south of Ensenada, Porto Rico. Collected by R. W. Miner.

***Nereis dumerillii* Audouin and Edwards**

Nereis dumerillii EHLERS, 1864-1869, p. 535. McINTOSH, 1900-07-10, p. 302. WEBSTER, 1879, p. 34.

Variously preserved specimens best identified by the paragnaths. Entrance to Guanica Harbor, Condado Rocks opposite Fort Geronimo, Porto Rico. Collected by R. W. Miner and R. C. Osburn.

***Nereis limbata* Ehlers**

Nereis limbata EHLERS, 1864-1869, p. 567. VERRILL, 1874, p. 590. WEBSTER, 1879, p. 35.

On mangroves between Ensenada and Guanica, Porto Rico. Collected by R. W. Miner.

***Nereis bairdii* Webster**

Nereis bairdii WEBSTER, 1884, p. 312.

Guanica Harbor, Porto Rico, Collected by R. W. Miner.

***Nereis versipedata* Ehlers**

Nereis versipedata EHLERS, 1887, p. 116.

Mouth of Guanica Harbor, Porto Rico. Collected by R. W. Miner.

***Nereis glandulata*, new species**

Plate XXX, Figures 1 to 6

Seventeen specimens ranging from 20 mm. to 90 mm. in length. Differentiated from other members of the genus by the arrangement of the paragnaths, and the gradual but very marked increase in the posterior parapodia due to accumulation of skin glands.

The species is further characterized by brown markings (Fig. 1). These occur on the dorsal surface of the peristomium, of which the posterior three-fourths is brown; on the dorsal posterior margin of each somite; on the part of the head which is prolonged anteriorly; and on the parapodia which, on this account, appear uniformly darker than the rest of the body. In large specimens, where the accumulation of skin-glands is greater, this color is more pronounced in the posterior segments. This description refers to specimens preserved in formalin. Those preserved in alcohol were more completely decolorized.

The prostomium (Fig. 1) is six-angled and at its greatest width, just anterior to the eyes, is just as broad as it is long.

There are four eyes which are provided with lenses, and which in most specimens are much less regular in outline than in the specimen figured.

Tentacles two; moderately long.

Palps longer than the tentacles, with terminal joint long and rounded or short and bluntly pointed according to the preservation.

Tentacular cirri four on each side; the longest reaching to the posterior border of the second setigerous somite (Fig. 1).

Pharynx (Figs. 2, 3) retracted in all specimens. In describing the paragnaths the conventional diagram of pharynx found in McIntosh, 'British Annelids,' II, part 2, p. 249, was used. I, two points, one in front of the other. II, oblique, crescent-shaped group—roughly three rows deep. III, large group—roughly three rows deep. IV, similar to II. V, lacking. VI, small rounded groups. VII and VIII, single row of from five to seven large teeth.

Jaws with four teeth below the terminal fang.

The tenth parapodium is figured (Fig. 4). Others essentially the same in proportion, except for the antero-posterior thickening in the posterior parapodia due to accumulation of skin glands. All rami blunt and thick, of almost equal length. Dorsal cirrus arising at base of notopodium and extending one-third of its length beyond the parapodium. Ventral cirrus very short, arising at base of neuropodium.

Setæ of two kinds. Those of dorsal ramus with long terminal joint finely toothed (Fig. 5). Dorsal setæ of ventral ramus the same; ventral setæ with short terminal joint, hooked at end and with spines on side (Fig. 6).

Rocks off Guanica Harbor, Porto Rico, 1915. Collected by A. L. Treadwell. Also collected in Guanica Harbor; entrance to Guayanilla Harbor; Salinas Cove; and Parguera, Porto Rico, by R. W. Miner. Type in Amer. Mus. Nat. Hist.

AMPHINOMIDÆ***Amphinome jamaicensis* Schmarda**

Amphinome jamaicensis SCHMARD, 1861, p. 143.

Near Guanica Harbor, Porto Rico. Collected by R. W. Miner.

Eurythoe complanata (Pallas) Ehlers

Eurythoe complanata EHLERS, 1887, p. 29.

Rocks off Guanica Harbor, Porto Rico. Collected by A. L. Treadwell.

CHRYSTOPETALIDÆ**Bhawania goodei** Webster

Bhawania goodei WEBSTER, 1884, p. 308.

Bermuda, 1916. Collected by A. L. Treadwell.

EUNICIDÆ**Nicidion kinbergi** Webster

Nicidion kinbergi WEBSTER, Bull. No. 25, U. S. Nat. Mus., p. 320.

Under flat coral reefs, Mangrove Island at Parguera, Porto Rico.

Lumbrinereis floridana Ehlers

Lumbrinereis floridana EHLERS, 1887, p. 103.

Surface of the sea, Bermuda, 1898.

ARICIDÆ**Aricia rubra** Webster

Aricia rubra WEBSTER, 1879, p. 53.

Mangrove Key, Key West, Florida. Collected by A. L. Treadwell, 1916.

SPIONIDÆ**Aonides cirrata** Sars

Aonides cirrata Sars, FAUVEL, 1914, p. 220.

Porto Rico. Collected by A. L. Treadwell.

TEREBELLIDÆ**Loimia bermudensis** Verrill

Loimia bermudensis VERRILL, 1900, p. 664.

Cane Wharf, Guanica Harbor, Porto Rico. Collected by R. C. Osburn.

AMPHARETIDÆ***Amage inhamata*, new species**

Plate XXX, Figures 7 to 9

Specimen mutilated; measuring 14 mm. in length exclusive of tentacles. Width, 5 mm.

Two pairs of tentacles are borne on the cephalic lobe, the most anterior of which are crenated along their anterior edges; the posterior smooth. The following four segments (all setigerous) bear tentacles similar to the posterior pair on the cephalic lobe (Fig. 7). Only one side of the animal is figured. The tentacles all taper from base to apex but are not sharply attenuated. They take their origin on the dorsal-lateral sides of the somites. The first pair extends back as far as the tenth somite.

In the type specimen the first four somites are equal in length, all being as wide as the diameter of the tentacles which they bear. Beginning with the fifth there is a gradual increase in width, the thirteenth being five times as broad as the fourth.

The spinulæ are very stout and long, light yellow in color, and have a blunt point with subterminal concavity like a spoon (Fig. 9). These occur on the posterior margins of the somites and are directed posteriorly.

The capillary setæ (Fig. 8) are very slender and attenuated and occur in the same setæ-bundle with the spinulæ. They are inconspicuous and few in number.

The specimen had only thirteen somites. In these there was no trace of hooks. The specimen has been placed here tentatively, the absence of hooks being a puzzling factor. More complete specimens are necessary for accurate determination.

Bermuda, 1901. Collected by A. L. Treadwell. Type in Amer. Mus. Nat. Hist.

SABELLIDÆ***Branchiomma lobiferum* Ehlers**

Branchiomma lobiferum EHLERS, 1887, p. 254.

Guanica Harbor, Porto Rico. Collected by R. W. Miner.

***Dasychone conspersa* Ehlers**

Dasychone conspersa EHLERS, 1887, p. 266.

Guanica Harbor, Porto Rico. Collected by R. W. Miner.

***Sabella melanostigma* Schmarda var.**

Plate XXX, Figures 10 to 15; Plate XXXI, Figures 1, 2

Sabella melanostigma SCHMARDA, 1861, p. 36. EHLERS, 1887, p. 263.

Length 65 mm. of which the gills represent 10 mm., the thorax 5 mm. Width 10 mm. in thoracic region, tapering very slightly toward the posterior end.

Number of somites 113 of which 8 are thoracic.

Color of specimen in alcohol pinkish purple shading into purple.

Gills 10 pairs: in color a pale pinkish lavender, the rachises having 3 or 4 pairs of fairly large pigment-spots along the outer edges (Plate XXX, fig. 10). No outer appendages. Pinnules decrease gradually to just proximal of rachistip which is free. Bases of rachises connected by a delicate low membrane. Basal portions of gills form prominent rounded structures on each side (Fig. 11).

Collar high, prominent, and recurved having ventral and ventro-lateral fissure^s, conspicuously marked by pigment-spots (Fig. 12). Collar widely separated dorsally with two large and prominent pigment-spots in the posterior-median angles (Fig. 11).

Four pigment-spots in each somite; two dorso-laterally and two ventro-laterally.

Ventral shields lighter in color than rest of body; rectangular in shape (Fig. 12) and having the same proportions throughout the body.

Small faecal groove ending almost imperceptibly in the mid-ventral line of the first abdominal somite.

Thoracic setæ lanceolate, of the winged variety (Fig. 13). Setæ of collar fascicle similar.

Uncini of both thorax and abdomen with crest of six or seven coarse denticulations (Fig. 14).

Pennoned setæ from thoracic torus small and unjointed (Fig. 15).

Capillary setæ of abdomen similar to those of thorax but more slender and pointed (Plate XXXI, fig. 1).

As the specimen described differed from Ehlers' account of *Sabella melanostigma* only in the number of thoracic somites, the length of the gills, and the coloration, it seemed best to regard it as a variety of *melanostigma*, since the differences found were not sufficiently great to regard it as a new species. That the species described by Schmarda is variable is further illustrated by other specimens in this collection from the same region.

The specimens were preserved separately and the pink coloring had disappeared, the purple markings remaining the same. The number of gills was greater than in the specimen described.

Four specimens were examined. Number of thoracic somites, 12-13 in three specimens. The fourth showed considerable variation in that it had 14 thoracic somites while the 15th was thoracic on the right side and abdominal on the left. Ehlers describes 15 thoracic somites for *S. melanostigma*.

There are 15-18 pairs of gills present.

The antennæ are about one-third of the gills in length and are recurved, Plate XXXI, fig. 2).

Porto Rico: tide pools and sheltered side of rocks at entrance of Condado Bay, off Fort Geronimo; Coral reef in bay, west of entrance to Guanica Harbor, inner side of reef—flat coral rocks, Ensenada. Collected by R. W. Miner. Specimen in Amer. Mus. Nat. Hist.

***Parasabella fonticula*, new species**

Plate XXXI, Figures 3 to 9

Length of body of type specimen 30 mm., 5 mm. of which is represented by the gills. Width 1 mm. Number of somites 79, of which 20 comprise the thorax. Posterior end of body mutilated.

There are eight pairs of white gills which curve outward at their distal ends and arise from a basal portion which is separated from the rest of the head by a slight demarcation. A short terminal portion of each rachis is naked. The bases of the rachises are united by a very delicate, low web. There are no eyes.

Tentacles slender, 1 mm. in length.

On the dorsal side the collar is low with ends widely separated (Fig. 3). On the ventral surface it is high with triangular recurved lobes nearly in contact in the mid-line. There is a thickened prominence on the head at the base of each lobe (Fig. 4).

Thoracic setæ: superior slender and regularly tapered (Fig. 5). Inferior ob lanceolate with extra median point (Fig. 6). Tori have avicular uncini with single tooth and basal bar (Fig. 7). Pennoned setæ (Fig. 8) with rather long terminal point accompany the uncini.

Abdominal setæ: inferior slender with flask-like terminal portion and long, pointed termination (Fig. 9). Avicular uncini like those of thorax (Fig. 7).

Outer reef south of entrance to Guanica Harbor, Porto Rico. Collected by R. W. Miner. Type in Amer. Mus. Nat. Hist.

***Parasabella midoculi*, new species**

Plate XXXI, Figures 10 to 14; Plate XXXII, Figures 1, 2

Body 40 mm. in length, 2 mm. in width in thoracic region, tapering gradually to 1 mm. in width at end of abdomen.

Characteristic feature, two groups of brown pigment-spots on each gill at the middle of the outer surface of the rachis.

Nine pairs of branchiæ joined at base by a small membranous web (Fig. 10). Pigment on rachises confined to two spots at middle of shaft. Figure 11 is a side view showing one side of the rachis only. Paired pinnæ. Tip of rachis naked for some distance.

Collar with only one incision (two-lobed); low, with ends separated on back (Fig. 10). Ventral ends elongated into blunt lobes which may be recurved (Fig. 12).

Avicular uncini without denticulations (Fig. 13), and pennoned setæ in tori on thorax (Fig. 14).

Avicular uncini in tori on abdomen.

The first torus is arranged obliquely just lateral to the dorsal free end of the collar. On the next seven somites the torus is ventral to the seta tuft. Throughout the remainder of the body the torus is dorsal to the seta tuft.

Setæ from third or fourth thoracic somite of two kinds: one slender and pointed with indication of lateral wing (Plate XXXII, fig. 1); the other form is heavier and rounded with a small low terminal point (Fig. 2).

Loggerhead Key, Florida. Collected by A. L. Treadwell. Type in Amer. Mus. Nat. Hist.

***Parasabella flecata*, new species**

Plate XXXII, Figures 3 to 8

Two specimens in good condition, the longer measuring 25 mm. of which 5 mm. belong to the gills. Width, 2.5 mm.

Number of somites 67. Not counting the collar fascicle, there are 7 thoracic setigerous somites. The tori on these are long, extending from the dorsal seta-bundle, which is situated dorso-laterally, as far as the ventral shield.

The faecal groove passes laterally between the seventh and eighth somites, cutting off the posterior corner of the eighth ventral shield.

Beginning with the eighth somite and passing throughout the remainder of the body, the tori are dorsal to the seta-bundles.

The collar is moderately high, two-lobed, with ends separated dorsally (Fig. 3). Ventrally the ends are bluntly triangular and almost in contact. Between the ends, the bases of the labial palps are seen. These are one-half mm. in height, triangular and situated between the gills (Fig. 4).

The head bears 16 pairs of branchiae 5 mm. in length. The gills are connected above the base by a very low, delicate web. On the base between the rachises there are longitudinal groups of pigment-spots. These are immediately below the connecting membrane (Figs. 3 and 4). Each gill has a naked terminal portion about one-half mm. in length. In both specimens the ends of the gills were curled over medially throughout 2.5 mm. of their length. The outer surface of each rachis is regularly marked with small light-brown pigment-spots throughout two-thirds of the length. In addition there are from 3 to 6 pigment-spots on the median side of each rachis and extending on the base of the pinnules.

Thoracic setae: superior setae lanceolate in form, with tapering end (Fig. 5). Setae in tori of two kinds: avicular uncini (Fig. 6) and small pennoned setae (Fig. 7).

Abdominal setae lanceolate but with much longer tapering end than is found on lanceolate setae on thorax (Fig. 8). Avicular uncini in tori the same as those in tori on thorax, but unaccompanied by pennoned setae.

Porto Rico. Collected by A. L. Treadwell. Type in Amer. Mus. Nat. Hist.

SERPULIDÆ***Protis torquata*, new species**

Plate XXXII, Figures 9 to 13

A small serpulid of a faint pink color and with green spots on the branchiae in alcoholic specimen.

Total length 15 mm. of which 3 mm. belong to the gills and 3 mm. to the thorax (not counting the upper part of the collar which covers the base of the gills). Width, 1 mm.

There are 6 setigerous somites in the thorax not counting the collar fascicle. The tori in each are ventral to the seta-bundles and are on the posterior edge of the somite in each case. They meet in the mid-ventral line.

The edge of the sixth setigerous somite is free ventrally and slightly recurved in the median line (Fig. 9).

The collar (Figs. 9, 10) is very high compared to that of *Protis simplex* described by Ehlers in his Florida Anneliden. It is one-lobed with a slight indication of division in the mid-ventral line. Dorsally its ends are separated and thrown into irregular folds along their median edges.

The gills are spiral consisting of 18 rachises on each side. On the inner surface of each rachis there are three or four irregular olive-green pigment-spots extending over the bases of the pinnules. The terminal portion of each rachis is free from pinnules for a short distance.

There is no operculum.

Setæ: superior setæ of the collar not simple, tapered blades, but having an expansion some distance from the tip (Fig. 11). Beyond the expansion, the setæ are toothed. Superior setæ below the collar fascicle regularly tapered (Fig. 12). Thoracic uncini (Fig. 13) similar to those of *Eupomatus uncinatus* figured by Ehlers (1881, p.285) but with more teeth than those of *E. uncinatus*. Abdominal setæ similar to those in the thorax.

The specimen is referred to the genus *Protis* on account of the absence of operculum, and the character of the collar setæ. (Cf. Bush, 1904, pp. 226-227.)

In crevices on outer side of rocks at entrance to Condado Bay, opposite Fort Geronimo, Porto Rico. Collected by R. W. Miner. Type in Amer. Mus. Nat. Hist.

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PLATE XXIX

Figs. 1-4. *Podarke guanica*.

1. Dorsal view of head $\times 60$.
2. Parapodium $\times 50$.
3. Typical dorsal and ventral seta $\times 350$.
4. Typical middle seta $\times 350$.

Figs. 5-10. *Lepidonotus notata*.

5. Dorsal view of head $\times 25$.
6. Elytron from 18th somite $\times 30$.
7. Elytra bearing parapodium from middle of body $\times 25$.
8. Ventral seta $\times 350$.
- 9-10. Dorsal setae $\times 350$.

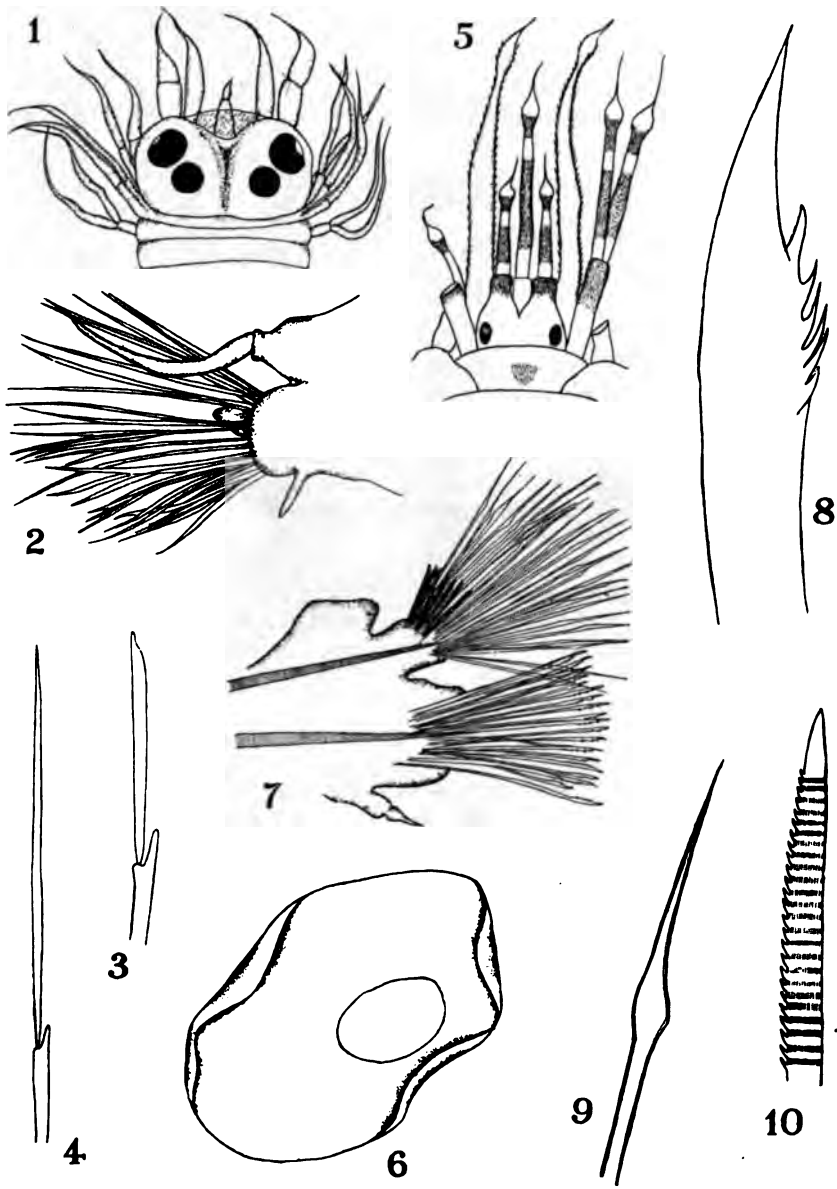


PLATE XXX

Figs. 1-6. *Nereis glandulata*.

1. Anterior end $\times 15$.
2. Diagrammatic dorsal view of pharynx $\times 10$.
3. Diagrammatic ventral view of pharynx $\times 10$.
4. Parapodium from 10th somite $\times 50$.
5. Dorsal seta $\times 350$.
6. Ventral seta $\times 350$.

Figs. 7-9. *Amage inhamata*.

7. Side view of anterior end $\times 33$.
8. Capillary seta $\times 350$.
9. Spinula $\times 350$.

Figs. 10-15. *Sabella melanostigma* var.

10. End of rachis showing eye-spot.
11. Dorsal view of anterior end $\times 8$.
12. Ventral view of anterior end $\times 8$.
13. Thoracic seta.
14. Thoracic uncinus.
15. Pennoned seta.

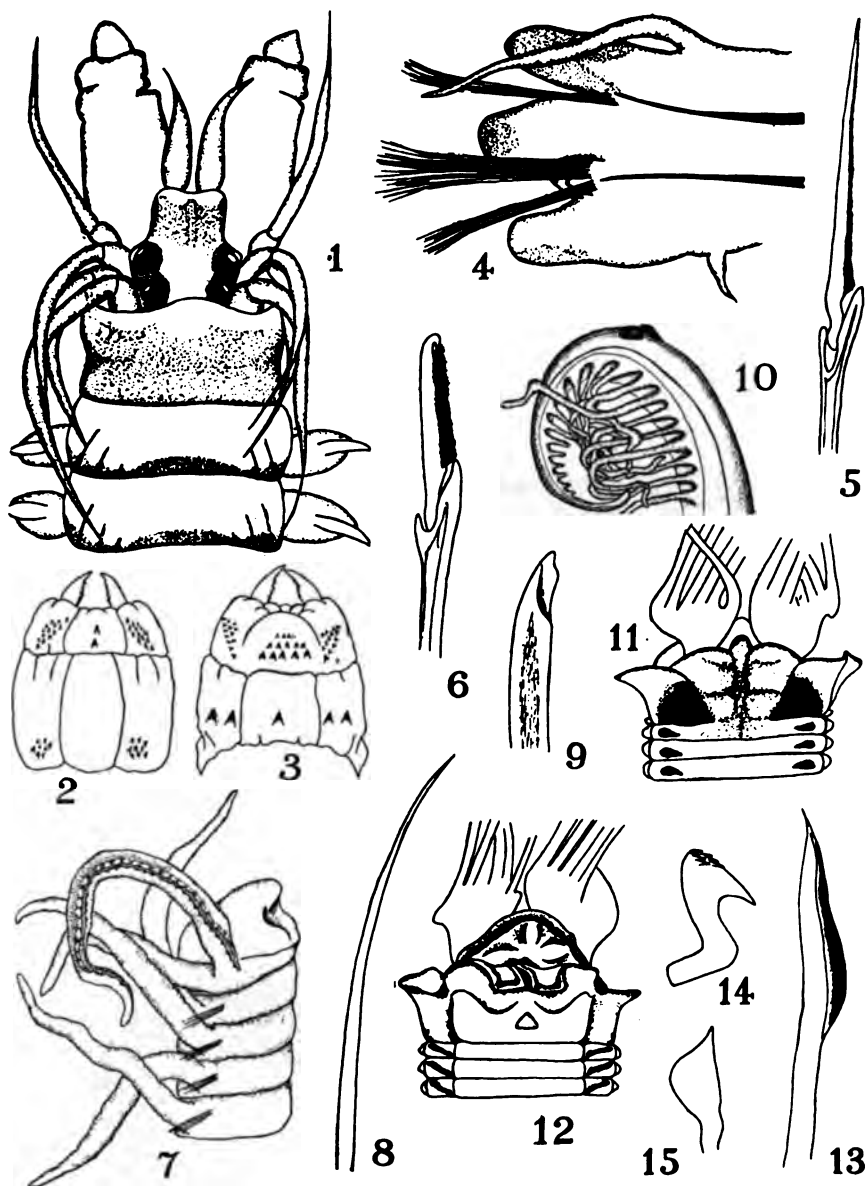


PLATE XXXI

Figs. 1-2. *Sabella melanostigma* var.

1. Abdominal seta.
2. Antenna $\times 7.5$.

Figs. 3-9. *Parasabella fonticula*.

3. Ventral view of head $\times 30$.
4. Dorsal view of head $\times 30$.
5. Superior thoracic seta $\times 175$.
6. Inferior seta $\times 175$.
7. Avicular uncinus (Thor.) $\times 350$.
8. Pennoned seta $\times 350$.
9. Inferior abdominal seta $\times 350$.

Figs. 10-14. *Parasabella midoculi*.

10. Dorsal view of anterior end $\times 30$.
11. Rachis with pigment-spots and pinnules.
12. Ventral view of anterior end $\times 30$.
13. Avicular uncinus (Thor.) $\times 350$.
14. Pennoned seta (Thor.) $\times 350$.

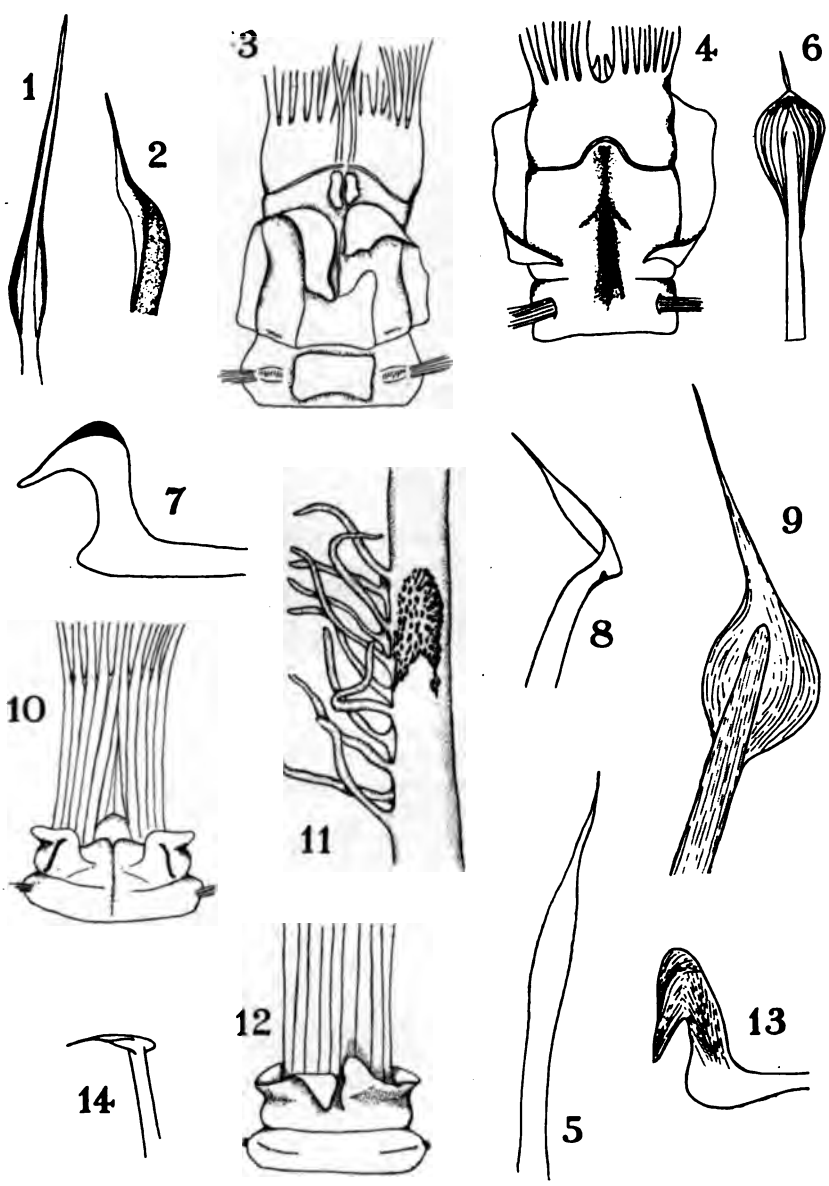


PLATE XXXII

Figs. 1-2. *Parasabella midoculi*.

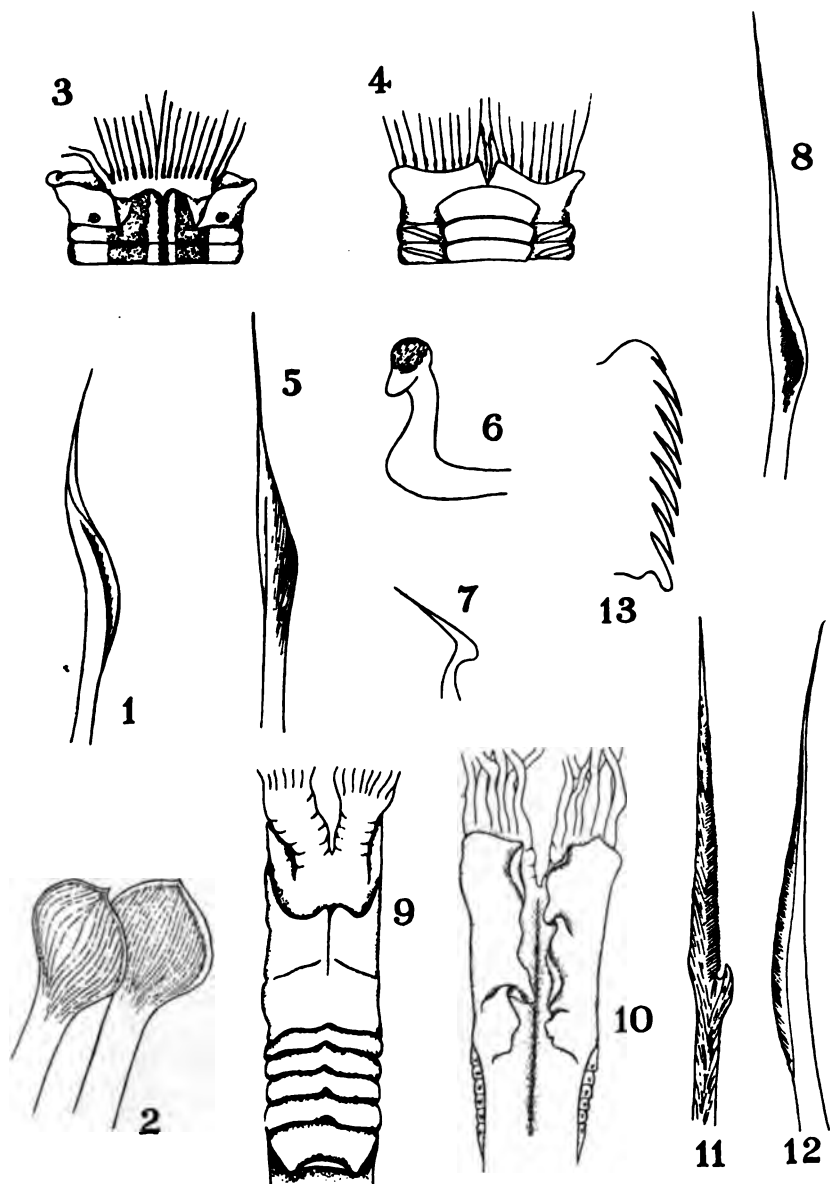
1. Thoracic seta $\times 350$.
2. Rounded seta $\times 350$.

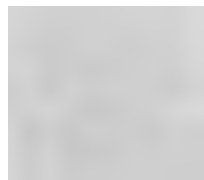
Figs. 3-8. *Parasabella flecata*.

3. Dorsal view of anterior end $\times 30$.
4. Ventral view of anterior end $\times 30$.
5. Superior thoracic seta $\times 350$.
6. Thoracic uncinus $\times 350$.
7. Pennoned seta (Thor.) $\times 350$.
8. Abdominal seta $\times 350$.

Figs. 9-13. *Protis torquata*.

9. Ventral view of anterior end $\times 30$.
10. Dorsal view of anterior end $\times 30$.
11. Seta from collar fascicle $\times 350$.
12. Superior thoracic seta.
13. Thoracic uncinus.





Article XVII.—A NEW SPECIES OF CRAB FROM JAPAN

BY MARY J. RATHBUN

***Eriocheir misakiensis*, new species**

Plate XXXIII, Figs. 1 and 2

TYPE LOCALITY.—Misaki, Japan; N. Yatsu, collector.

TYPE.—Female (Cat. No. 3221, Amer. Mus. Nat. Hist.).

MEASUREMENTS.—Type female, length of carapace 10.3, fronto-orbital width 9.3, greatest width of carapace 10.3 mm.

DIAGNOSIS.—Front bilobed. Sides of carapace nearly parallel. Only two lateral teeth besides the orbital tooth.

DESCRIPTION.—Surface pubescent. Carapace everywhere uneven. Epigastric and protogastric ridges low. Edge of front divided into two shallow lobes by a broad median sinus. Lateral margins nearly straight and nearly parallel as they converge but slightly toward the orbits; two teeth besides the tooth at the orbit, their tips sharp-pointed. Post-lateral granulate ridge straight, uniting with the lateral margin without forming a tooth.

Outer maxillipeds much as in *E. japonicus* de Haan¹ but the antero-external angle of the merus is more arcuate, less truncate.

Chelipeds of female very short and weak, when extended not much longer than the carapace; a small, triangular spine at inner angle of wrist. Fingers longer than palm, both having longitudinal ridges and lines of setæ, prehensile edges furnished with fine, irregular teeth fitting close together.

Legs narrower than usual, the merus of the first three legs with a small, sharp spine near the extremity of the upper margin.

RELATIONSHIPS.—Differs from *E. japonicus*, *E. sinensis*,² and *E. rectus*³ in lacking a third tooth on the lateral margin and in having the front bilobed instead of quadri-lobed. *E. leptognathus*⁴ has, like the new species, only two lateral teeth, but its front is trilobed and the outer maxillipeds are typically narrow. *E. misakiensis* is unique in the nearly parallel side margins of the carapace.

¹*Grapæus (Eriocheir) japonicus* de Haan, 1835, Fauna Japon., Crust., p. 59, Pl. xvii.

²Milne Edwards, 1854, Arch. Mus. Hist. Nat., Paris, VII, p. 146, Pl. ix, figs. 1-1c.

³Stimpson, 1858, Proc. Acad. Nat. Sci. Phila., X, p. 103.

⁴Rathbun, 1913, Proc. U. S. Nat. Mus., XLVI, No. 2030, p. 353.



Fig. 1. Dorsal view



Fig. 2. Ventral view

Eriocheir misakiensis, new species. Type; The American Museum of Natural History No. 3221. $\times 2\frac{1}{4}$.



20

1. The first part of the document is a list of names and addresses. The names are: John Doe, Jane Doe, and John Doe. The addresses are: 123 Main St, 456 Main St, and 789 Main St. The list is as follows:

Name	Address
John Doe	123 Main St
Jane Doe	456 Main St
John Doe	789 Main St

2. The second part of the document is a list of names and addresses. The names are: John Doe, Jane Doe, and John Doe. The addresses are: 123 Main St, 456 Main St, and 789 Main St. The list is as follows:

Name	Address
John Doe	123 Main St
Jane Doe	456 Main St
John Doe	789 Main St

3. The third part of the document is a list of names and addresses. The names are: John Doe, Jane Doe, and John Doe. The addresses are: 123 Main St, 456 Main St, and 789 Main St. The list is as follows:

Name	Address
John Doe	123 Main St
Jane Doe	456 Main St
John Doe	789 Main St

4. The fourth part of the document is a list of names and addresses. The names are: John Doe, Jane Doe, and John Doe. The addresses are: 123 Main St, 456 Main St, and 789 Main St. The list is as follows:

Name	Address
John Doe	123 Main St
Jane Doe	456 Main St
John Doe	789 Main St

5. The fifth part of the document is a list of names and addresses. The names are: John Doe, Jane Doe, and John Doe. The addresses are: 123 Main St, 456 Main St, and 789 Main St. The list is as follows:

Name	Address
John Doe	123 Main St
Jane Doe	456 Main St
John Doe	789 Main St

6. The sixth part of the document is a list of names and addresses. The names are: John Doe, Jane Doe, and John Doe. The addresses are: 123 Main St, 456 Main St, and 789 Main St. The list is as follows:

Name	Address
John Doe	123 Main St
Jane Doe	456 Main St
John Doe	789 Main St

7. The seventh part of the document is a list of names and addresses. The names are: John Doe, Jane Doe, and John Doe. The addresses are: 123 Main St, 456 Main St, and 789 Main St. The list is as follows:

Name	Address
John Doe	123 Main St
Jane Doe	456 Main St
John Doe	789 Main St

8. The eighth part of the document is a list of names and addresses. The names are: John Doe, Jane Doe, and John Doe. The addresses are: 123 Main St, 456 Main St, and 789 Main St. The list is as follows:

Name	Address
John Doe	123 Main St
Jane Doe	456 Main St
John Doe	789 Main St

9. The ninth part of the document is a list of names and addresses. The names are: John Doe, Jane Doe, and John Doe. The addresses are: 123 Main St, 456 Main St, and 789 Main St. The list is as follows:

Name	Address
John Doe	123 Main St
Jane Doe	456 Main St
John Doe	789 Main St

10. The tenth part of the document is a list of names and addresses. The names are: John Doe, Jane Doe, and John Doe. The addresses are: 123 Main St, 456 Main St, and 789 Main St. The list is as follows:

Name	Address
John Doe	123 Main St
Jane Doe	456 Main St
John Doe	789 Main St

**Article XVIII.—A NEW RODENT FROM THE UPPER
OLIGOCENE OF FRANCE**

BY GERRIT S. MILLER, JR. AND JAMES W. GIDLEY

PLATE XXXIV

In the Cope collection of fossils there is a fragmentary skull of a *Spalax*-like rodent from France, labeled "Butte calc., Poirrier." The animal which it represents is of unusual interest; but the insufficiency of the data accompanying the specimen has hitherto discouraged any attempts at exact determination. Recently, in response to our inquiry, Professor Cl. Gaillard, Director of the Museum of Lyons, has fully supplied the lacking information. The letter which Professor Gaillard has had the kindness to write on the subject is of such interest that we take the liberty of printing a part of it as an appendix to this article. The exact history of the specimen is briefly as follows. Poirrier discovered the fossil in a calcareous butte at Peu-Blanc, commune of Sorbier, about seventeen kilometers northeast of St. Gérard-le-Puy, Allier. He knew in 1859 that it represented an undescribed genus related to *Spalax* and that the specimen was complete enough to furnish the basis of a description; but, so far as we can ascertain, no technical account of the animal was ever published. Hence the present paper appears to be, after a lapse of nearly sixty years, the first answer to Poirrier's expectation that his specimen would become the type of a new genus and species.

RHIZOSPALAX, new genus

(Family Rhizomyidæ)

TYPE.—*Rhizospalax poirrieri*, new species.

CHARACTERS.—Palate and mandible essentially as in *Tachyoryctes*; teeth essentially as in *Spalax*.

Rhizospalax poirrieri, new species

TYPE.—Palate including m^1 and m^2 of both sides, and nearly complete mandible (lacking coronoid and articular processes) with entire dentition (m^3 broken). No. 11013, American Museum of Natural History. Collected at Peu-Blanc, Department of the Allier, France, by B. Poirrier. Upper Oligocene.

SKULL.—As compared with a specimen of *Tachyoryctes splendens* (No. 184133, U. S. National Museum), with which it approximately agrees in size, the palate and mandible of *Rhizospalax poirrieri* show the following peculiarities.

Palate.—Region between toothrows nearly parallel-sided (not narrowed anteriorly as in *Tachyoryctes* by the encroachment of broadened teeth); median ridge low and lateral grooves shallow and ill-defined in region between toothrows, but more pronounced than in *Tachyoryctes* in region extending from level of first tooth to posterior border of palatal foramina; region in front of toothrow less bent upward; base of zygomatic plate sloping upward at a noticeably less abrupt angle (apparently almost as nearly horizontal as in *Myospalax*); pits for reception of incisor roots not visible on outer surface of palate, well defined on the broken upper surface, their position in the bone nearly as in *Tachyoryctes*, but slightly more posterior, so as to lie somewhat internal to the toothrows and distinctly overhang the root of the first molar; median posterior emargination of palate extending forward almost if not quite to level of posterior border of alveolus of m^2 (its margin is slightly chipped away at middle).

Mandible.—General outline less arcuate; region between cheekteeth and incisor longer, deeper, and more robust as compared with the ascending ramus; lower angle of postsymphysal buttress situated beneath middle of diastema instead of beneath anterior margin of m_1 ; flange formed by angular process set more obliquely to axis of mandible, its width greater, and the concavity of its inner surface deeper; surface for attachment of masseter muscle with better marked ridgelets for muscle attachment; anterior margin of this area bounded by a conspicuous oblique ridge continued downward from base of coronoid process; area for attachment of temporal muscle between toothrow and coronoid process wider, particularly in region opposite the small m_2 .

TEETH.—Molars resembling those of *Spalax*, but both above and below rapidly graduated in size from first to third, the second conspicuously smaller than first, the third with crown-area a little more than one-third that of first in lower jaw, and

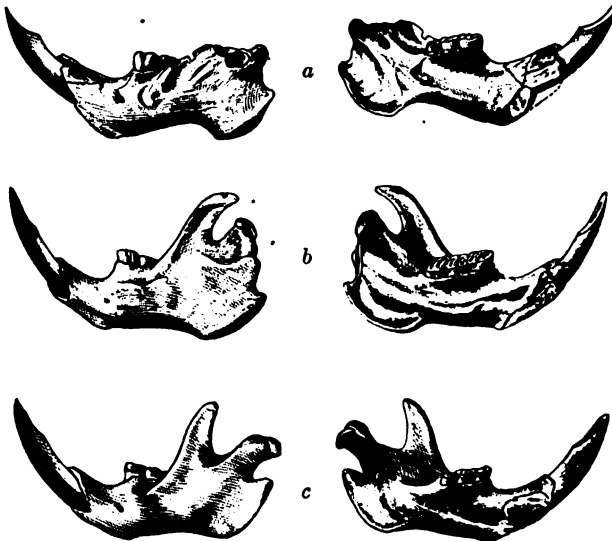


Fig. 1. Mandible of *Rhizospalax* (a), *Tachyoryctes* (b), and *Spalax* (c). Natural size.

probably less than half that of first in upper jaw (it is broken away at level of alveolus). First and second upper teeth 3-rooted; first and second lower teeth 2-rooted; third tooth single rooted. Enamel pattern in the upper teeth and the second and third lower teeth not generically distinguishable from that of *Spalax*; first lower tooth with a complete enamel rim infolded at middle of outer side; surface of the crown with four narrow transverse lakes, the anterior of which is in communication with the outer rim (the second from behind is accompanied by a small cavity in the osteodentine; it superficially resembles another lake and may represent the last trace of one that has been nearly worn away).

Upper incisor not known. Lower incisor like that of *Tachyoryctes splendens* except that the shaft is more rounded and its anterior face has no trace of a median ridge. The projecting capsule over root of incisor on outer surface of ascending ramus is broken away. From the size of its base it appears to have been larger than in *Tachyoryctes* but less developed than in *Spalax*.

MEASUREMENTS.—Length of mandible from posterior extremity of angular process to anterior border of alveolus of incisor $31 \pm$ mm.; depth of mandible between m_1 and m_2 , 7.8 mm.; least depth of mandible immediately in front of tooth-row, 7.0 mm.; least width of palate at level of m^1 , 3.8 mm.; width of alveolus of m^1 , 3.2 mm.; upper tooththrow (alveoli), 6.6 mm.; lower tooth-row (alveoli), 8.0 mm.

COMPARISONS.—While the skull of *Rhizospalax* has more features of agreement with that of *Tachyoryctes* than with that of any of the other known Rhizomyine and Spalacine rodents, it shows agreement with *Spalax* and *Myospalax* in certain details. The very slight upward bend of the palate in front of tooththrows suggests both of these genera; the position and direction of the basal portion of the zygomatic plate suggests *Myospalax*, though the posterior rim of the bone is noticeably thicker and its under surface shows no trace of the concavity so conspicuous in *Myospalax*, *Spalax* and *Tachyoryctes*. So little remains of the zygomatic root, however, that no great stress can be laid on these peculiarities. The posterior emargination of the palate is essentially as in *Myospalax*. The general form of the mandible is probably more nearly as in *Spalax* than in *Tachyoryctes*; it is very different from that in *Myospalax*. On the other hand, the postsymphyseal buttress is absent in *Spalax* while in *Rhizospalax* it has essentially the same high development found in *Myospalax*. From the skull of *Spalax* that of *Rhizospalax* differs widely: in the position, close to the tooththrow, of the root of the zygomatic plate, and of the pits for reception of the incisor roots; in the deep posterior emargination of the palate; in the form of the angular process; in the presence of a conspicuous postsymphyseal buttress. From the skull of *Myospalax* it differs in the general outline of the mandible, the form of the angular process, the conspicuous ridge at anterior margin of area for masseteric insertion, and the projecting of the incisor root on outer side of ascending ramus. Sufficient comparison with the skull of *Tachyoryctes* has already been made.

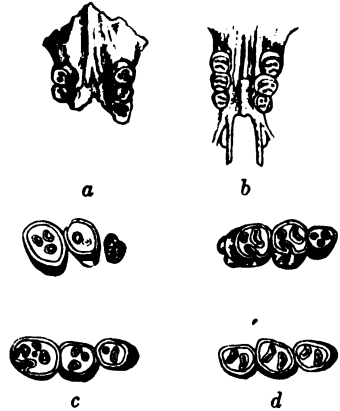


Fig. 2. Palate of *Rhizospalax* (a) and *Spalax* (b). Natural size. Teeth of *Rhizospalax* (c) and *Spalax* (d). $\times 2$.



Fig 1. Dorsal view



Fig. 2. Ventral view

Eriocheir misakiensis, new species. Type; The American Museum of Natural History No. 3221. $\times 2\frac{1}{4}$.

surtout si vous n'avez pas connaissance de la brochure de B. Poirrier. D'après les fossiles recueillis à Peu-Blanc et signalés par B. Poirrier, tels que *Sciurus chalanzi* Pomel, *Cricetodon gerardianus* Gervais, les documents de la collection Poirrier proviendraient en grande partie de gisements analogues et de même âge que ceux qui ont fourni les fossiles de la faune dite de St. Gérard-le-Puy et qui ont été trouvés à Langy, Montaignu-le-Blin, Boucé, St. Gérard-le-Puy, etc. Ces gisements renferment la faune aquitaniennne, ils appartiennent à l'Oligocène tout à fait supérieur. "Butte calc." désigne sans doute les nombreux mamelons ou buttes calcaires que j'ai visités il y a une dizaine d'années et qui étaient exploités à St. Gérard-le-Puy, ainsi que dans les environs, pour la fabrication de la chaux. Ci-joint un croquis-[Fig. 3] montrant la position géographique des principales localités d'ou proviennent les fossiles de la collection Poirrier et ceux de St. Gérard-le-Puy.

.....
Tout heureux d'avoir l'occasion de vous être agréable, je vous prie de me croire,
cher Monsieur

votre bien cordialement

Gaillard

Directeur du Muséum de Lyon

C. M. Z. S.

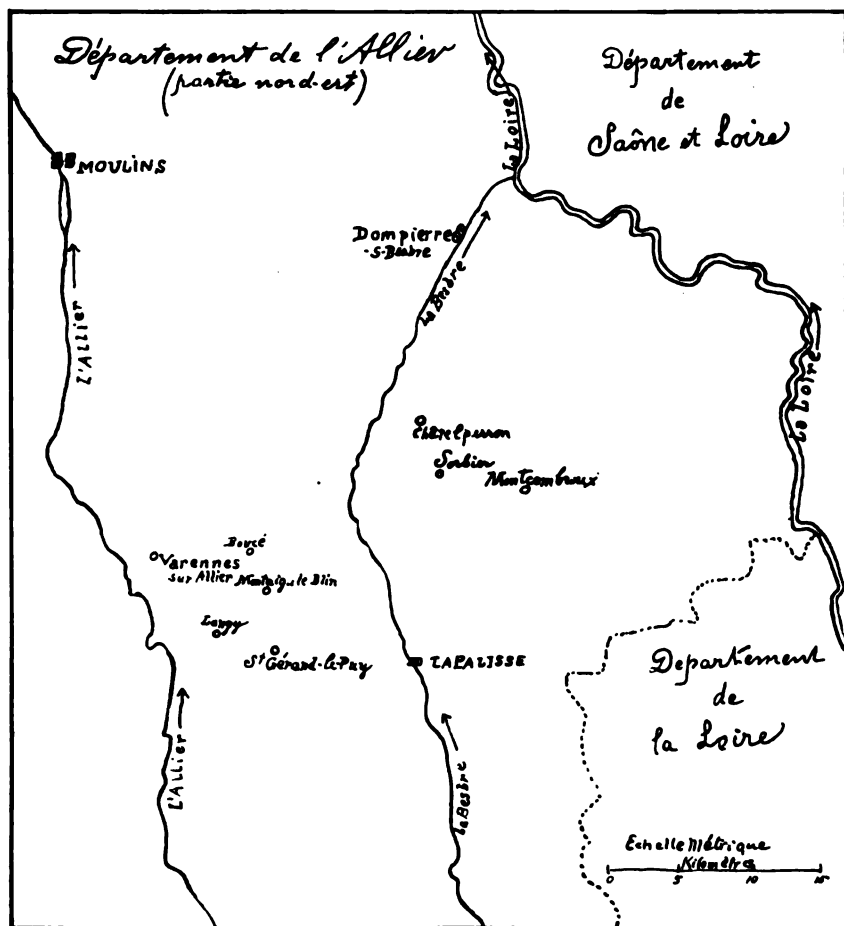


Fig. 3. Map of region including Sorbier and St. Gérard-le-Puy.



PLATE XXXIV

(Photographs, natural size)

- Fig. 1.** *Spalaz*. Four views of mandible.
- Fig. 2.** *Rhizospalaz*. Four views of mandible.
- Fig. 3.** *Tachyoryctes*. Four views of mandible.
- Fig. 2a.** Palate of *Rhizospalaz* from below.
- Fig. 2b.** Palate of *Rhizospalaz* from above, showing pits for reception of incisor roots.
- Fig. 3a.** Palate of *Tachyoryctes* from below.
- Fig. 3b.** Palate of *Tachyoryctes* from above, showing pits for reception of incisor roots.



1



2



3



1



2



3



2a

2b



3a

3b

Article XIX.—BRYOZOA OF THE CROCKER LAND EXPEDITION

BY RAYMOND C. OSBURN

OHIO STATE UNIVERSITY, COLUMBUS, OHIO

The bryozoan fauna of the Greenland coastal waters is probably better known than that of any other extensive coastline except that of western Europe and the adjacent islands. For many years Greenland has been a center of attack for arctic exploration and a number of the expeditions have collected material in this group. American expeditions, for the most part, have hitherto been concerned especially with geographical exploration and have done little or nothing with the smaller marine animals. The Peary Auxillary Expedition, in 1894, secured a small collection of twenty-seven species in this group, which were identified by Hennig. The zoologists of Denmark, Norway, Sweden, England, Russia, and Germany have thus far made all the studies on Greenland Bryozoa.

The Bryozoa from collections made by various expeditions to Greenland have been dealt with in more or less detail by fourteen different authors in as many separate contributions. However, as none of these papers is generally accessible in America and, as few of them are in English (the others being in Latin, German, Swedish, and Norwegian), the writer has deemed it advisable to review the literature briefly and to append a complete list of species known from that region.

The earliest mention of Greenland Bryozoa is found in the 'Fauna Groenlandica' (O. Fabricius, 1780). Fifteen species are mentioned, but the descriptions are so inadequate and the synonymy so doubtful that in some cases it is not possible to make out what species were meant.

In 1867, Smitt,¹ the Swedish naturalist, listed seventy-five species and "forms" as occurring in Greenland, though synonymy has now reduced this list to about seventy. Many of Smitt's "forms" have been raised to the rank of species.

Kirchenpauer in 1874 listed twenty-six species from eastern Greenland.

Lütken, 1875, prepared a list, without data, of sixty-four species known from Greenland, in the 'Manual and Instructions for the Arctic Expedition,' for use by the 'Valorous' expedition to Davis Strait. The difference between this list and the larger one of Smitt is probably to be accounted for by the unnecessary sinking of certain good species

¹For title see bibliography.

in synonymy. Lütken's list was also published, without localities, in Rink's 'Danish Greenland' in the same year.

Hincks in 1877 listed, with localities, nineteen species from Davis Strait, in his paper 'On Polyzoa from Iceland and Labrador' and described two new species. Through some error these species from Davis Strait were credited to Iceland, a mistake which Hincks himself later cleared up (See 'Polyzoa of the St. Lawrence,' Ann. Mag. Nat. Hist., (6) I, p. 218, footnote 2).

Busk (1881) listed sixteen species collected by Captain Feilden of the North Polar Expedition and described two new species.

Hennig (1896) studied the material taken by the Peary Auxillary Expedition in 1894 and listed, with data, twenty-seven species from Northumberland I., Murchison Sound and Inglefield Gulf, in the northernmost part of Baffin Bay.

Vanhöffen (1897) listed ninety-eight species, twenty-eight of these from Karajakfjord, taken by the Greenland Expedition of the Berlin Gesellschaft für Erdkunde in 1892-1893.

Andersson (1902), in the report on the Swedish expedition of 1898-1899, listed twenty-four species from various localities on the eastern coast of Greenland. One new species is described.

Bidenkap (1905) gives a table showing the general geographic distribution of arctic Bryozoa, in which he records sixty-eight species as occurring in Greenland.

Norman (1906) prepared a list, without distributional data, of seventy-eight species taken in the 'Valorous' dredgings in Davis Strait, to which he added twenty-six from Lütken's list (a few of which are of doubtful validity), making, if all are to be accepted, a hundred and four species.

Kluge's paper (1907) on 'Bryozoa von West-Grönland' lists seventy-five species and varieties from the following points: Upernivik, Karnah, Foulke Fjord, Murchison Sound, Payer and Battle Harbors, Robertson, Granville, Olriks and Barden Bays, Capes York, Alexander and Chalon, Saunders and Northumberland Islands. One new species is described.

Mortensen (1911) described a new species of Endoprocta, *Loxosomella antedonis*, from northeast Greenland and subdivided the genus *Loxosoma*, erecting in addition two new genera, *Loxocalyx* and *Loxosomella*.

Finally (1916), a paper by the late Dr. G. M. R. Levinsen, published posthumously, gives a list of sixty-seven species from various localities along the coast of northeast Greenland; Stormbugt; Danmarks Havn:

Oresund; Cape Bismarck; the sound between Renskaeret and Maatten; 76° 35' N. lat., 18° 26' W. Long.; and 77° N. Lat., 18° 30' W. Long. Two new genera are erected, *Harmeria*, to include the *Lepralia scutulata* of Busk, and *Lepraliella*, to include *Lepralia hippopus* Smitt and *Cellepora contigua* Smitt. Also two new species are described. The paper is further valuable for its extended discussion of numerous species. For example, the *Lepralia spathulifera* of Smitt, which has been a sort of shuttlecock for the amusement of systematists, is definitely shown to belong to the genus *Callopora* among the *Membraniporas*.

Hitherto, one hundred and eighty species and varieties have been recorded from Greenland. In the present report six more species are added to the list and six others, which have been recorded heretofore for the eastern coast only, are new to the western coast of Greenland. This list, totaling one hundred and eighty-six species and varieties, is surprisingly large when one considers the narrowly limited conditions under which marine life exists in that region. Although Greenland extends from about latitude 60° to above latitude 83° and has several thousand miles of coast-line, the water temperature ranges closely about the zero mark (centigrade) the year round. The surface temperature in winter and summer varies not more than ten degrees off the southernmost point of Greenland, while farther north there is still less variation. At one hundred meters depth all the shorewise waters apparently have a temperature of zero or lower throughout the year.

Naturally, most of the Greenland species are typically arctic and a large number of these are circumpolar in their distribution. Some of the species, to be sure, occur also farther south on the American and European coasts, and *Crisia eburnea* and *Microporella ciliata* are cosmopolitan.

The collections made by the Crocker Land Expedition were taken at Etah, on Foulke Fjord, Lat. 78° 20' and at Umanak, Lat. 76° 30'. Peeawahto Point, the other locality mentioned in the following report, is only two miles east of Etah. These localities are well to the north on the western side of Greenland, on Smith Sound, north of Baffin Bay. The amount of material taken was certainly not extensive, but fifty-one species are represented, as many as would be expected from any similar amount from the tropics or elsewhere and all of the major groups of the marine Bryozoa are represented. The collection, unless otherwise indicated in the text, was made by Dr. M. C. Tanquary, in the year 1914. The southern and eastern coasts of Greenland are more open and more accessible and the Bryozoa are consequently much better known.

The species new to the Greenland fauna are:

Nolella dilatata (Hincks),
Electra monostachys (Busk),
Callopora discreta (Hincks),
Callopora spitzbergensis (Bidenkap),
Cribriolina punctata (Hassall),
Cheilopora prælucida (Hincks).

BRYOZOA TAKEN BY THE CROCKER LAND EXPEDITION
ENDOPROCTA

***Loxosomella antedonis* Mortensen.** This species lives attached to the free-living crinoids and was described from northeast Greenland at a latitude of 77° (See Mortensen, 1911, p. 399 *et seq.*) from specimens taken on *Hathometra proliza*. A small broken specimen of the crinoid *Heliometra glacialis* (Leach) was included among the bryozoan material from Etah, Foulke Fjord, and on this was found a single specimen of this simple bryozoan. Other crinoids of this species were carefully examined later, but no further specimens of the *Loxosomella* were found. It is possible that it may be found wherever arctic crinoids occur, but it is so small that it is easily overlooked.

***Barentsia major* Hincks.** Etah, Foulke Fjord; dredged August 7; attached to hydroid stems. The species ranges southward on the American coast to southern New England.

ECTOPROCTA

CYCLOSTOMATA

***Crisia eburnea* (Linn).** Etah, Foulke Fjord; dredged August 7; a few colonies, mostly young, attached to shells, hydroid stems and *Membranipora serrulata*.

***Tubulipora flabellaris* (Fabricius).** Etah, Foulke Fjord; dredged August 7. One young colony without ovicells apparently belongs here.

***Icmonea atlantica* Johnston.** Etah, Foulke Fjord; dredged August 7; one portion of a colony.

***Entalophora clavata* (Busk).** Etah, Foulke Fjord; dredged August 7; two small erect portions, 5 mm. in height, with partially developed ovicells. Thus far this species has been recorded for Greenland by Kluge only.

***Lichenopora crassiuscula* (Smitt).** Umanak, June 9; a few colonies on algæ.

***Lichenopora hispida* (Fleming).** Etah, Foulke Fjord, June 29, 1915; two colonies on a shell of *Margarites umbilicalis*.

Lichenopora verrucaria (Fabricius). Umanak, June 9; very abundant on algæ, hydroid stems, etc., many with completed ovicells, but no compound colonies were observed. One beautifully symmetrical colony was attached to the shell of a small living gastropod.

CTENOSTOMATA

Alcyonidium mamillatum Alder. Etah, Foulke Fjord; dredged August 7; one colony on a hydroid stem.

Bowerbankia caudata (Hincks). Etah, Foulke Fjord, August 7; a few small colonies attached to *Membranipora serrulata*, hydroids and algæ, and Umanak, July 13, 1914, on algæ.

Nolella dilatata (Hincks). Etah, Foulke Fjord; August 7; on algæ. This species has not hitherto been reported from Greenland. It is the *Cylindracium dilatatum* of Hincks and most other writers.

CHEILOSTOMATA

Gemellaria loricata (Linn.). Umanak, July 13, and Etah, Foulke Fjord, August 7; dredged, common.

Dendrobeania murrayana var. **fruticosa** (Packard). Etah, Foulke Fjord; dredged August 7. Rather common and mostly attached to *Membranipora serrulata*. Colonies well developed, 30 mm. or more in height and with numerous oœcia containing eggs in various stages of development.

Scrupocellaria scabra var. **pænulata** Norman. Occurring with the following species, but less common. In Greenland this variety is known only from the west coast.

Scrupocellaria ternata (Solander). Etah, Foulke Fjord; dredged late in July to August 7.

Scrupocellaria ternata var. **gracilis** Smitt. Taken with the preceding, but much more common.

Caberea ellisi (Fleming). Umanak, July 13; dredged; a few small colonies.

Electra monostachys (Busk). Umanak, July 13; two small colonies on algæ. This species has not hitherto been recorded from Greenland, but is a well-known northern species and in arctic regions has been recorded by Waters from Franz Josef Land (Bry. from Franz Joseph Land, Linn. Soc. Journ. Zool., XXVIII, p. 59, 1900), and by Nordgaard from the Kara Sea (Bryozoa, Duc d'Orleans, 1912, Campagne Arctique de 1907, p. 7).

Membranipora serrulata (Busk). Abundant at Etah, Foulke Fjord; dredged late in July to August 7. The encrusting stage is scarcely represented, nearly all the colonies being erect, 50 mm. or more in height, dichotomously branching, flabellate and altogether having a very *Flustra*-like appearance. The branches are narrow, usually not more than 4 to 5 mm. in breadth, and occasionally are almost round. These specimens are not so heavily calcified as those which I have previously studied from farther south (Bryozoa from Labrador, etc., 1912, Proc. U. S. Nat. Mus., XLIII, p. 279), and in the form of the zoarium resemble them but slightly. Some of them are more or less flexible, especially near the tips, according to the state of calcification. The older portions of the colony seem especially suited for the attachment of other species of Bryozoa.

This species, without doubt, belongs to *Membranipora* as limited by Levinsen (1909, Morph. and Syst. Studies on the Cheil. Bry., p. 144), as there are no oöcia, spines, or avicularia and there are two rosette plates in the distal and in each lateral wall. The eggs, when mature, pass to the anterior end of the zoöcium, directly under the operculum, where they appear to be enclosed by an uncalcified membrane.

Callopora arctica (d'Orbigny). Etah, Foulke Fjord, August 7; one colony on a dead shell picked up on the beach; Umanak, July 13, 1914, two colonies on living bivalve shells brought up with the holdfasts of *Laminaria*, and Peewahto Point, on shells of *Serripes grænlandicus*.

Callopora craticula (Alder). Umanak, July 9, and Etah, Foulke Fjord, August 7; dredged on *Membranipora serrulata*, *Dendrobeania* and on algæ. Also at Peewahto Point, Sept. 7, 1914, on shells of *Serripes grænlandicus*. Small but mature colonies with oöcia.

Callopora cymbæformis (Hincks). Abundant on hydroid stems and the erect Bryozoa, dredged at Etah, Foulke Fjord, late in July to August 7. Two colonies were also taken at Etah, June 29, 1915, one on a barnacle and the other on a shell of *Buccinum tanquaryi*. This species is almost never found except on the erect stems of other sessile organisms.

Callopora discreta (Hincks). Etah, Foulke Fjord; dredged August 7; one colony on a shell. This species has not previously been recorded for Greenland. Bidentkap (1905, p. 12), lists it for Spitzbergen.

Callopora nigrans (Hincks). Etah, Foulke Fjord; dredged August 7; one colony on a dead shell.

Callopora spathulifera (Smitt). Etah, Foulke Fjord; dredged August 7; two colonies on a dead shell.

Callopora spitzbergensis (Bidenkap). Etah, Foulke Fjord; dredged August 7; two portions, one of which is entirely bilaminate, the other partially so. The species has hitherto been taken only in Spitzbergen waters, but it is highly probable that it will be found to be circumpolar in its distribution.

Callopora unicornis (Fleming). Etah, Foulke Fjord; dredged August 7; one small colony of only a few zoecia, but well developed, with oecia. Also at Peeawahto Point, Sept. 7, on a shell of *Pecten islandicus*, collected by Mr. W. Elmer Ekblaw.

Callopora unicornis var. **armifera** (Hincks). Etah, Foulke Fjord, June 29, 1915; on shells of *Buccinum tanquaryi* and *B. ekblawi*, collected by Messrs. M. C. Tanquary, W. Elmer Ekblaw, and E. O. Hovey.

Cribrilina annulata (Fabricius). Umanak, July 13; two small colonies on algæ.

Cribrilina punctata (Hassall). Peeawahto Point; one colony on a shell picked up on the beach.

The typical form of this species has not hitherto been listed for Greenland, though it is recorded from various localities in arctic Europe. Anderson (1902, p. 541) described the variety *watersi* from eastern Greenland, but in the one small specimen of the present collection I can detect none of the varietal differences mentioned by him.

Hippothoa hyalina (Linn.) Umanak, June 9; several colonies encrusting small gastropod shells taken on algæ, and July 9, many colonies on the fronds of algæ and thick incrustations on the stems. Etah, Foulke Fjord, dredged August 9, a few very small colonies on *Membranipora serrulata* and more mature ones on shells of *Buccinum belcheri* and *Margarites umbilicalis* collected by Mr. W. Elmer Ekblaw.

Harmeria scutulata (Busk). Etah, Foulke Fjord; dredged August 7; three colonies on algæ, none larger than the head of a pin, but all mature.

Retepora elongata Smitt. Etah, Foulke Fjord; dredged August 7; four small colonies among *Dendrobeania*.

Myrionozoum crustaceum (Smitt). Etah, Foulke Fjord; dredged August 9; two very small specimens on *Membranipora serrulata*.

This species appears to have been a misfit generically and has accordingly been much shifted about by various authors. Levinsen (1909, Cheil. Bry., p. 297) erected the new genus *Myrionozella* to include it, but in 1916 (p. 469) returned to the use of the older genus *Myrionozoum*. Dawson (1859, Geol. Survey of Canada for 1858, p. 256) described this

species as *Lepralia plana*, and this name has been considerably used, but the description is inadequate for determination and it would appear that Smitt's specific name should stand in spite of the apparent priority.

Smittina minuscula (Smitt). Etah, Foulke Fjord, Sept. 7; one small, but mature colony on a shell of *Serripes grænlandicus*. This species has been listed for Greenland by Levinsen and Kluge only, but it is probable that some of the earlier records for *S. landsborovi* refer rather to *minuscula*.

Smittina reticulato-punctata (Hincks). Etah, Foulke Fjord; dredged August 7; one colony on a hydroid stem.

Smittina smitti (Kirchenpauer). Etah, Foulke Fjord; dredged August 7; one colony on a shell.

Smittina solida (Stimpson). Etah, Foulke Fjord; dredged August 7; several colonies among *Dendrobeatia* and *Membranipora serrulata*.

Mucronella indivisa (Levinson). Etah, Foulke Fjord; dredged August 7; one colony on a worm tube.

Mucronella ventricosa (Hassall). Peeawahto Point, Sept. 7; on shells of *Serripes grænlandicus* and *Pecten islandicus*, collected by Mr. W. Elmer Ekblaw.

Rhamphostomella costata (Hincks). Etah, Foulke Fjord; dredged August 7; one small colony on a hydroid stem.

Rhamphostomella ovata (Smitt). Peeawahto Point, June 29, 1915; one colony on a dead shell.

Rhamphostomella plicata (Smitt). Etah, Foulke Fjord, August 7; on a dead shell.

Porella concinna (Busk). Etah, Foulke Fjord, August 7; several small colonies on shells.

Cysticella saccata (Busk). Etah, Foulke Fjord; dredged August 7; one small, but apparently old colony, only 7 mm. in height and without branches, but heavily calcified secondarily at the base, with oöcia near the tip and beyond this about one row of young zoöcia.

This genus has been recently split off from *Porella* on what appears to be a perfectly satisfactory group of characters, by Canu and Bassler (1917, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bull. 96, U. S. Nat. Mus., Feb. 27, p. 53). The recent species belonging to this genus are *Porella saccata* (Busk) (= *P. elegantula* of most authors); *Porella elegantula* d'Orbigny (= *P. perpusilla* Busk), and *Porella fragilis* Levinsen (= *P. elegantula* var. *rostrata* Hincks).

Cylindroporella tutulosa (Norman). Umanak, July 13; one colony on the shell of a living bivalve mollusk brought up with *Laminaria* holdfasts; Peeawahto Point, Sept. 7, on a shell of *Serripes grænlandicus*, and Etah, June 29, 1915, on shells of *Buccinum ekblawi* and *B. tanquaryi*.

Hippoporina pertusa (Esper). Etah, Foulke Fjord; dredged August 7; one colony on shell.

Chelopora prælucida (Hincks). Etah, Foulke Fjord; dredged August 7; colonies of various sizes on hydroid stems, algæ, *Dendro-berania* and *Cellepora surcularis*. In the latter case a colony nearly an inch across extended in a unilaminar expansion from branch to branch of the *Cellepora*.

Cellepora surcularis (Packard). Etah, Foulke Fjord; dredged August 7; two portions of colonies, the largest over an inch in height and showing the usual mode of branching.

LIST OF GREENLAND BRYOZOA

The following table of one hundred and eighty-six species and varieties includes all that have been recorded for Greenland. Each author who has recorded a species is indicated by a check mark and the date following the author's name refers to the paper in which the occurrence is recorded. (See bibliography.) A glance at the table will show that numerous species, such as *Idmonea atlantica*, *Lichenopora verrucaria*, etc., are so common and widely distributed that they have been listed by practically every author from Fabricius to the present. Others are less common, and a few have been noted by only one author. Some of the records by earlier writers may be questionable, as our knowledge of the species has increased so rapidly in recent years, but in most cases these have been substantiated by later records, provided the synonymy is correct. Three species mentioned by Lütken (*Flustra foliacea*, *Smitina linearis* and *S. reticulata*), and *Membranipora membranacea* recorded by Fabricius, have not been noticed by any later writer and these especially must be looked upon with suspicion.

ENTOPROCTA		Osburn, <i>vide ante</i> Levensen, 1916	Mortensen, 1911	Kluge, 1907	Norman, 1906	Bidenkap, 1905	Andersson, 1902	Vanhöffen, 1897	Hennig, 1896	Busk, 1881	Hincks, 1877	Lütken, 1875	Kirchenpauer, 1874	Smitt, 1867	Fabricius, 1780
<i>Somella antedonis</i>	Mortensen	x	x												
" <i>phascalosomatum</i>	(Vogt)						x								
<i>Somoma</i>	sp. Andersson						x								
"	sp. Lütken											x			
"	sp. Vanhöffen							x							
<i>Sia</i>	<i>gracilis</i> (Sars)					x		x							
"	<i>major</i> Hincks						x	x							
"	<i>variarticulata</i> Andersen						x								
ECTOPROCTA															
Cyclostomata															
<i>Sia</i>	<i>arctica</i> Sars			x											
"	<i>cornuta</i> (Linnæus)													x	
"	<i>denticulata</i> (Lamarek)					x		x	x		x			x	
"	<i>eburnea</i> (Linnæus)			x		x		x				x		x	
"	<i>producta</i> Smitt				x										
<i>Pubulipora</i>	<i>fimbria</i> Lamarek					x		x				x			x
"	<i>flabellaris</i> (Fabricius)	x		x		x		x				x	x	x	x
"	<i>liliacea</i> (Pallas)				x	x		x							
"	<i>ventricosa</i> Busk					x				x	x				
"	sp. Levensen		x												
<i>Idmonea</i>	<i>atlantica</i> Johnston	x	x		x	x		x	x		x	x	x	x	
<i>Entalophora</i>	<i>clavata</i> (Busk)	x		x											
"	<i>deflexa</i> Smitt						x								
<i>Hornera</i>	<i>lichenoides</i> (Linnæus)				x	x	x	x				x	x	x	
<i>Lichenopora</i>	<i>crassiuscula</i> (Smitt)	x	x		x										
"	<i>hispida</i> (Fleming)	x				x		x				x	x	x	
"	<i>regularis</i> (d'Orbigny)		x												
"	<i>verrucaria</i> (Fabricius)	x	x		x	x		x	x		x	x	x	x	x

	Osburn	Levinson	Kluge	Norman	Bidenkap	Anderson	Vanhöffen	Hennig	Busk	Hincks	Lütken	Kirchenpauer	Smitt	Fabricius
<i>Stomatopora fungia</i> (Couch)			x		x		x	x			x		x	
“ <i>incrassata</i> (Smitt)			x		x		x				x		x	
“ <i>major</i> (Johnston)				x										
“ <i>penicillata</i> (Fabricius)					x		x				x			x
<i>Diasopora diasporoides</i> (Norman)		x	x	x	x		x	x						
“ <i>meandrina</i> Wood					x		x		x		x		x	
“ <i>obelica</i> (Johnston)		x		x	x		x				x	x	x	
“ “ <i>var. arctica</i> Waters			x											
“ <i>simplex</i> Smitt											x		x	
“ <i>suborbicularis</i> Hincks					x		x							
<i>Defrancia lucernaria</i> (Sars)					x		x				x		x	
<i>Reticulipora intricaria</i> (Smitt)						x								
Ctenostomata														
<i>Flustrella hispida</i> (Fabricius)					x		x				x			x
<i>Alcyonidium disciforme</i> (Smitt)						x								
“ <i>gelatinosum</i> (Linnæus)				x	x	x	x				x	x	x	
“ <i>hirsutum</i> (Fleming)				x	x	x	x				x		x	
“ <i>mamillatum</i> Alder	x	x		x	x	x	x					x	x	
“ “ <i>var. robustum</i> Anderson						x								
“ <i>mytili</i> Dalyell		x												
<i>Bowerbankia arctica</i> (Busk)			x				x		x					
“ <i>caudata</i> (Hincks)	x	x												
<i>Buskia nitens</i> Alder							x			x				
<i>Nolella dilatata</i> (Hincks)	x													
Cheilostomata														
Anasca														
<i>Gemellaria loricata</i> (Linnæus)	x	x		x	x		x	x			x		x	x
<i>Bugula plumosa</i> (Pallas)					x									x
<i>Dendrobeatia murrayana</i> (Johnston)				x	x		x		x		x		x	
“ “ <i>var. fruticosa</i> (Packard)	x	x	x	x			x	x	x	x				
“ “ <i>var. quadriden-</i> <i>tata</i> (Loven)		x	x			x								
<i>Sarsiflustra abyssicola</i> (Sars)						x								
<i>Flustra carbacea</i> Solander							x						x	
“ <i>foliacea</i> (Linnæus)											x			
“ <i>membranaceo-truncata</i> Smitt				x	x	x	x						x	
“ <i>papyracea</i> Ellis and Solander											x		x	
<i>Scrupocellaria reptans</i> (Linnæus)					x									x
“ <i>scabra</i> (Van Beneden)		x			x		x	x		x	x		x	x
“ “ <i>var. elongata</i> (Smitt)				x	x							x	x	
“ “ <i>var. pænulata</i> Norman														
“ <i>ternata</i> (Solander)	x	x	x	x	x		x	x			x		x	

[illegible]

	Osburn	Levinson	Kluge	Norman	Bidenkap	Andersson	Vanhöffen	Hennig	Busk	Hincks	Lütken	Kirchenpauer	Smitt	Fabricius
<i>Relepora cellulosa</i> (Linnæus)					X						X		X	
" <i>elongata</i> Smitt	X	X	X		X					X			X	
<i>Myriozoum coarctatum</i> (Sars)				X			X	X	X	X	X		X	
" <i>crustaceum</i> (Smitt)	X	X	X	X	X		X	X		X	X		X	
" <i>subgracile</i> (d'Orbigny)			X	X	X		X		X	X	X		X	X
<i>Schizoporella biaperta</i> (Michelin)			X	X	X		X						X	
" <i>cruenta</i> (Busk)			X	X	X		X							
" <i>elmwoodiae</i> Waters			X											
" <i>ortmanni</i> Kluge			X											
" <i>producta</i> Packard)			X											
" <i>sinuosa</i> (Busk)		X		X	X		X					X	X	
" <i>stylifera</i> (Levinson)		X	X											
" <i>unicornis</i> (Johnston)		X			X		X							
" <i>vulgaris</i> Moll)		X												
<i>Microporella ciliata</i> (Pallas)		X			X		X				X		X	X
" " <i>var. arctica</i> (Norman)			X	X	X									
<i>Fenestrulina malusi</i> (Audouin)					X		X				X		X	
<i>Smittina auriculata</i> (Hassall)			X	X	X		X				X		X	
" <i>bella</i> (Busk)			X	X	X		X							
" <i>jeffreysi</i> (Norman)		X	X	X	X		X	X		X				
" <i>landsborovi</i> (Johnston)					X		X				X	X	X	
" <i>linearis</i> (Hassall)											X			
" <i>majuscula</i> (Smitt)			X										X	
" <i>minuscula</i> (Smitt)	X	X	X											
" <i>porifera</i> (Smitt)		X	X	X	X		X	X			X		X	
" <i>propinqua</i> (Smitt)		X	X	X	X		X			X			X	
" <i>reticulata</i> (Macgillivray)											X			
" <i>reticulatopunctata</i> (Hincks)	X	X	X	X	X	X				X		X		
" <i>smitti</i> (Kirchenpauer)	X	X			X		X					X	X	
" <i>solida</i> (Stimpson)	X					X	X				X		X	
" <i>trispinosa</i> (Johnston)											X		X	
" " <i>var. arborea</i> Levinson						X		X						
<i>Mucronella abyssicola</i> (Norman)		X		X										
" <i>immersa</i> (Fleming)			X	X	X		X					X		
" <i>indivisa</i> (Levinson)	X	X												
" <i>labiata</i> (Boeck)		X	X		X	X	X							
" <i>ventricosa</i> (Hassall)	X	X	X		X	X	X						X	
<i>Escharoides jacksoni</i> (Waters)		X			X	X					X		X	
<i>Rhamphostomella bilaminata</i> (Hincks)		X												
" <i>costata</i> (Hincks)	X		X	X										
" <i>ovata</i> (Smitt)	X		X	X									X	
" <i>plicata</i> (Smitt)	X	X	X	X	X		X	X		X			X	

SYNONYMY

In the following synonymy I have indicated only those names of species previously recorded for Greenland, which differ from the terminology herein used. I do not consider the synonymy as settled by any means. Changes in the arrangement of genera and even in the conception of genera and, to some extent, of larger groups as well, have recently been made at such a rate that it is difficult for even the special student of the bryozoa to keep track of them. Greater intensive study of morphological and embryological characters, and difference of opinion as to what is most fundamental, are responsible for most of these changes in classification. This is true, not only for the rarer forms, but also for some of the oldest and best known species.

The classification was at first based on the most superficial characters of the colony. This was supplanted by a similar, but much more satisfactory arrangement on the basis of the superficial characters of the individual. But more recent studies, especially those of Waters, Jullien, Levinsen, Harmer, and Canu, have shown that comparatively little reliance can be placed on external characters and that the broader features of the classification must rest on more fundamental structures. Many new genera have been proposed and old families have been broken up and rearranged or new ones established. At the same time, Levinsen chose to make use of some of the old "classical" generic names under a new interpretation, a plan which tends rather to confusion than to clarity. To my mind it would have been better to allow these genera to die a natural death and enter the limbo of zoological misconceptions than to attempt to resuscitate them. At present it seems impossible to harmonize all the changes that have been made.

In the present list I have made use of the newer generic names where I could be certain of the position of the species, but in other cases I have retained older genera, with the full realization that they will have to succumb to the progress of study. Gradually the Bryozoa will emerge from the chaotic state of classification in which they now are, just as other groups have done, but the end is not yet clearly in sight.

CYCLOSTOMATA

Lozosomella phascalosomatum (Vogt).

Lozosoma, Andersson, 1902.

Barentsia gracilis (Sars).

Pedicellina, Vanhöffen, 1897; Bidentkap, 1905.

Tubulipora fimbria Lamarck.

Tubipora serpens, Fabricius, 1780.

Tubulipora flabellaris (Fabricius).

Tubipora, Fabricius, 1780.

Tubulipora liliacea (Pallas).

Idmonea serpens, Hennig, 1896; Vanhöffen, 1897; *I. serpens* and *T. liliacea*, Bideknapp, 1905; *I. liliacea*, Norman, 1906.

Lichenopora hispida (Fleming).

Discoporella, Smitt, 1867; Kirchenpauer, 1874; Lütken, 1875.

Lichenopora verrucaria (Fabricius).

Madrepore, Fabricius, 1780; *Discoporella*, Smitt, 1867; Kirchenpauer, 1874; Lütken, 1875; Hincks, 1877.

Stomatopora fungia (Couch).

Tubulipora, Smitt, 1867; Lütken, 1875.

Stomatopora penicillata (Fabricius).

Tubipora, Fabricius, 1780; *Tubulipora*, Lütken, 1875. This species may be synonymous with *S. fungia*, but, until this can be finally proved, they should be recorded separately.

Diasopora diasporoides (Norman).

Stomatopora, Hennig, 1896; Vanhöffen, 1897; Norman, 1906; Kluge, 1907.

Diasopora meandrina Wood.

Mesenteripora, Smitt, 1867; Lütken, 1875; Busk, 1881.

Diasopora obelia (Johnston).

D. hyalina forma *obelina*, Smitt, 1867; *D. hyalina*, Kirchenpauer, 1874; Lütken, 1875. There is a possibility that *D. simplex* Smitt may be identical.

CTENOSTOMATA

Flustrella hispida (Fabricius).

Flustra, Fabricius, 1780; *Alcyonidium*, Lütken, 1875.

Alcyonidium mamillatum Alder.

A. hirsutum forma *mamillata*, Smitt, 1867; *A. hirsutum* forma *membranacea*, Kirchenpauer, 1874.

Bowerbankia arctica (Busk).

Farrella, Busk, 1881. This species may well be only a variety, or perhaps even identical with *B. imbricata* Adams, though the zoecia are larger in the far northern form.

Nolella dilatata (Hincks).

This species is the *Cylindracium dilatatum* of Hincks. Harmer has clearly shown (Polyzoa of the Siboga Expedition, pp. 52-53) that *Cylindracium* Hincks must give way to *Nolella* Gosse.

CHEILOSTOMATA

Gemellaria loricata (Linnæus).

Fistularia ramosa, Fabricius, 1780.

Bugula plumosa (Pallas).

Sertularia fastigiata, Fabricius, 1780.

Dendrobeania murrayana (Johnston) and varieties *fruticosa* (Packard) and *quadridentata* (Loven). Previous to 1908, when Levinsen erected the genus *Dendrobeania* (Morph. and Syst. Studies on the Cheilostomata), all records for this species and its varieties were listed under *Bugula*.

Sarsiflustra abyssicola (Sars).

Flustra, Andersson, 1902.

Flustra papyracea Ellis and Solander.

F. chartacea, Smitt, 1867; Lütken, 1875.

Flustra membranaceo-truncata Smitt.

Carbasea, Norman, 1906.

Scrupocellaria reptans (Linnæus).

Sertularia, Fabricius, 1780.

Scrupocellaria scabra (Van Beneden).

Sertularia halecina, Fabricius, 1780; *Cellularia scabra*, Lütken, 1875. The variety *elongata* was listed by Smitt, 1867, as *Cellularia scabra forma elongata*; by Kirchenpauer 1874, as *Scrupocellaria inermis*; and by Bidekap, 1905, as *S. scruposa*.

Scrupocellaria ternata (Solander).

Cellularia ternata and *forma gracilis* Smitt, 1867; *Cellularia*, Lütken, 1875; *Menipea* Hennig, 1896; Vanhöffen, 1897; Bidekap, 1905; Norman, 1906; Kluge, 1907. The variety *gracilis*, as *Menipea gracilis*, Busk, 1881; Vanhöffen, 1897; Norman, 1906.

Menipea arctica Busk.

Scrupocellaria, Kluge, 1907.

Menipea smitti (Norman).

M. duplex, Vanhöffen, 1897.

Electra pilosa (Linnæus).

Membranipora, Smitt, 1867; Lütken, 1875; Vanhöffen, 1897; Bidekap, 1905.

Membranipora membranacea (Linnæus).

Flustra, Fabricius, 1780.

Membranipora serrulata (Busk).

Flustra, Busk, 1881; Hennig, 1896; Vanhöffen, 1897; Kluge, 1907.

Callopora. This genus, erected by Gray and amended by Norman, contains most of the species formerly listed under *Membranipora*. It is marked by the presence of avicularia or oecia or both. Levisen (Morph. and Syst. Studies on the Cheilostomatous Bryozoa, p. 152) has erected a new genus *Tegella* to include *C. arctica* and *C. unicornis*, but until further work has been done on this point it may be better to include these species under *Callopora*. Additional changes in the synonymy of this genus are as follows:

Callopora arctica (d'Orbigny).

Membranipora lineata forma *sophia* Smitt, 1867; *M. sophia* Hincks, 1877; *C. sophia*, Norman, 1906.

Callopora lineata (Linnæus).

Flustra, Fabricius, 1780.

Callopora minax (Busk).

Membranipora, Kirchenpauer, 1874; Vanhöffen, 1897; *Rhamphonotus*, Bidekap, 1905.

Callopora nigrans (Hincks).

Membranipora, Kluge, 1907.

Callopora spathulifera (Smitt).

Lepræa, Smitt, 1867; Lütken, 1875; Vanhöffen, 1897; Bidekap, 1905; Kluge, 1907. This well-known and easily determined species has been much shifted

about, though, as it happens, all Greenland records refer it to *Lepralia* prior to the work of Levinsen, 1916, pp. 441-442. Levinsen's study of this species appears to show conclusively that its relations are with *Callopora*.

Callopora spinifera (Johnston).

Membranipora, Vanhöffen, 1897; Bidekap, 1905.

Callopora cymbaformis (Hincks).

Membranipora spinifera, Smitt, 1867; Lütken, 1875.

Callopora unicornis var. *armifera* (Hincks).

Membranipora lineata forma *americana*, Smitt, 1867; *Callopora sophia*, Norman, 1906.

Cribrilina annulata (Fabricius).

Cellepora, Fabricius, 1780; *Escharipora*, Lütken, 1875.

Cribrilina nitidopunctata (Smitt).

Gephyrotes, Norman, 1906.

Microporina articulata (Fabricius).

Isis hippuris, Fabricius, 1780; *Cellaria*, Smitt, 1867; Lütken, 1875; *Cellaria borealis*, Hennig, 1896; *Cellaria*, Vanhöffen, 1897; *C. borealis*, Bidekap, 1905; *Cellularia*, Norman, 1906; *Micropora borealis*, Kluge, 1907.

Hippothoa divaricata Lamouroux.

Mollia hyalina forma *divaricata*, Smitt, 1867.

Hippothoa hyalina (Linnaeus).

Cellepora, Fabricius, 1780; *Mollia*, Smitt, 1867; *Lepralia*, Kirchenpauer, 1874; *Mollia*, Lütken, 1875; *Schizoporella*, Vanhöffen, 1897; *Celleporella*, Bidekap, 1905.

Harmeria scutulata (Busk).

Cribrilina, Kluge, 1907.

Relepora beaniana King.

R. cellulosa forma *beaniana*, Smitt, 1867.

Relepora elongata Smitt.

R. cellulosa forma *notopachys* var. *elongata*, Smitt, 1867; *R. wallichiana*, Hincks, 1877; Bidekap, 1905; Levinsen, 1916.

Myrionozoum coarctatum (Sars).

Leieschara, Vanhöffen, 1897; Norman, 1906.

Myrionozoum crustaceum Smitt.

Leieschara, Vanhöffen, 1897; *Schizoporella*, Bidekap, 1905; *Leieschara*, Norman, 1906.

Myrionozoum subgracile (d'Orbigny).

Millepora truncata, Fabricius, 1780; *Leieschara*, Vanhöffen, 1897; Norman, 1906.

Schizoporella biaperta (Michelin).

Escharella lineata forma *biaperta*, Smitt, 1867.

Schizoporella cruenta (Norman).

Mucronella, Bidekap, 1905.

Schizoporella sinuosa (Busk).

Escharella linearis forma *secundaria*, Smitt, 1867; *Lepralia*, Kirchenpauer, 1874.

Schizoporella vulgaris (Moll.).

Escharina, Levinsen, 1916.

Microprella ciliata (Pallas).

Cellepora, Fabricius, 1780; *Porina*, Smitt, 1867; Lütken, 1875.

Fenestrulina malusi (Audouin).

Porina, Smitt, 1867; Lütken, 1875; *Microporella*, Vanhöffen, 1897; Bidekap, 1905.

Smittina auriculata (Hassall).

Escharella, Smitt, 1867; Lütken, 1875; *Schizoporella*, Vanhöffen, 1897; *Schiz. auriculata* and *Sm. lineata*, Bidekap, 1905; Norman, 1906; *Sm. lineata*, Kluge, 1907.

Smittina bella (Busk).

Smittina, Vanhöffen, 1897; *Porella*, Bidekap, 1905; Norman, 1906; *Porella normani*, Kluge, 1907.

Smittina jeffreysi (Norman).

Lepralia trispinosa var., Hincks, 1877; *Sm. trispinosa* var. *jeffreysi* Hennig 1896; *Sm. trispinosa*, Vanhöffen, 1897; *Smittia*, Bidekap, 1905.

Smittina landsborovi (Johnston).

Lepralia, Kirchenpauer, 1874; *Escharella*, Lütken, 1875; *Smittia landsboroughii* forma *crystallina*, Vanhöffen, 1897; *Smittia*, Bidekap, 1905. It is probable that some of these records refer to *Smittina majuscula* or *Sm. minuscula*.

Smittina porifera (Smitt).

Escharella, Smitt, 1867; Lütken, 1875; *Smittia*, Hennig, 1896; Vanhöffen, 1897; Bidekap, 1905; *Schizoporella*, Kluge, 1907.

Smittina reticulata (Macgillivray).

Escharella lagentilii, Lütken, 1875. Bidekap identifies the *Esch. lagentilii* forma *prototypa* of Smitt with *Sm. reticulata*. The only Greenland record for this species is that of Lütken, which is open to some doubt, as the species of *Smittina* were none too well understood in his time.

Smittina reticulato-punctata (Hincks).

Hemeschara contorta, Kirchenpauer, 1874; *Lepralia*, Hincks, 1877; *Lepralia*, Andersson, 1902; Norman, 1906; *Schizoporella*, Kluge, 1907.

Smittina smitti (Kirchenpauer).

Escharella lagentilii forma *prototypa*, Smitt, 1867; *Lepralia smitti*, Kirchenpauer, 1874; *Smittia lagentilii*, Vanhöffen, 1897.

Smittina solida (Stimpson).

Escharella palmata, Smitt, 1867; Lütken, 1875; *Smittia palmata*, Vanhöffen, 1897; Andersson, 1902.

Smittia trispinosa (Johnston).

Escharella jacotini, Smitt, 1867; Lütken, 1875.

Mucronella abyssicola (Norman).

Escharella laqueata, Norman, 1906; *Escharella*, Levinsen, 1916.

Mucronella immersa (Fleming).

Lepralia peachii, Kirchenpauer, 1874; *M. peachii*, Vanhöffen, 1897; *Escharella*, Norman, 1906; *M. peachii*, Kluge, 1907.

Mucronella indivisa (Levinson).

Escharella, Levinson, 1916.

Mucronella labiata (Boeck).

Phylactella, Andersson, 1902; *Escharella*, Levinson, 1916.

Mucronella ventricosa (Hassall).

Discopora coccinea forma *ventricosa*, Smitt, 1867; *Escharella*, Levinson, 1916.

Escharoides jacksoni (Waters).

Discopora appensa, Smitt, 1867; Lütken, 1875; *M. coccinea*, Vanhöffen, 1897.

Rhamphostomella bilaminata (Hincks).

Discopora, Levinsen, 1916.

Rhamphostomella ovata (Smitt).

Cellepora scabra forma *ovata*, Smitt, 1867.

Rhamphostomella plicata (Smitt).

Cellepora scabra forma *plicata*, Smitt, 1867; *Cellepora*, Hincks, 1877; Hennig, 1896; *C. scabra* forma *plicata*, Vanhöffen, 1897; *Discopora*, Levinsen, 1916.

Rhamphostomella radiatula (Hincks).

Discopora, Levinsen, 1916.

Rhamphostomella scabra (Fabricius).

Millepora reticulata, Fabricius, 1780; *Cellepora*, Smitt, 1867; Kirchenpauer, 1874; Lütken, 1875; Hennig, 1896; Vanhöffen, 1897; *Discopora*, Levinsen, 1916.

Escharopsis rosacea (Sars).

Eschara, Smitt, 1867.

Escharopsis sarsi (Smitt).

Cellepora spongiles, Fabricius, 1780; *Eschara sarsii*, Smitt, 1867; *Escharoides*, Lütken, 1875; *Eschara*, Busk, 1881; *Escharopsis lobata*, Norman, 1906; *Discopora*, Levinsen, 1916. Julien (Résultats des Campagnes Scientifiques du Prince de Monaco, XXIII, p. 88) . . . has erected a new genus, *Posterula*, for this species.

Umbonula arctica (Sars).

Mucronella pavonella, Vanhöffen, 1897; Bidekap, 1905; Norman, 1906; Kluge, 1907; *Discopora pavonella*, Levinsen, 1916. This species has commonly been known as *Mucronella pavonella* (Alder), but Nordgaard (1917, Bry. from the Arctic Regions, Tromsø Museums Aarshefter 40, No. 1, p. 79) shows that Alder's name must give way to the *arctica* of Sars. Harmer (1902, Morphology of the Cheilostomata, Q. J. M. S., XLVI, part 2, N. S., p. 296, Pl. xv, fig. 10), has shown that the species properly belongs in the genus *Umbonula*, if that genus is to be retained, on account of its close structural relationship to *U. verrucosa*.

Porella compressa (Sowerby).

Eschara cervicornis, Smitt, 1867; Kirchenpauer, 1874; Lütken, 1875; *Cellepora cervicornis*, Busk, 1881.

Porella grænlandica (Norman).

P. bella var. *grænlandica*, Norman, 1906.

Porella skenei (Solander).

Discopora, Smitt, 1867; Lütken, 1875; *Cellepora*, Kirchenpauer, 1874; *Palmicellaria*, Vanhöffen, 1897; Bidekap, 1905. The variety *tridens* (Busk), as *Palmicellaria skenei* var. *tridens*, Norman, 1906.

Cysticella elegantula (d'Orbigny).

Eschara perpusilla, Busk, 1881; *Porella perpusilla*, Vanhöffen, 1897; Bidekap, 1905; *Porella elegantula*, Norman, 1906; Kluge, 1907.

Cysticella fragilis (Levinsen).

Porella saccata var. *rostrata*, Kluge, 1907; *Porella fragilis*, n. sp., Levinsen, 1916.

Cysticella saccata (Busk).

Eschara elegantula, Lütken, 1875; Busk, 1881; *Porella elegantula*, Hennig, 1896; Vanhöffen, 1897; *Porella saccata*, Bidekap, 1905; Kluge, 1907.

Cylindroporella tubulosa (Norman).

Porina Vanhöffen, 1897; Kluge, 1907.

Lepraliella contigua (Smitt).

Cellepora ramulosa forma *contigua*, Smitt, 1867; *Rhamphostomella*, Norman, 1906; *Lepralia*, Kluge, 1907. Levinsen, 1916, p. 466, erects the new genus *Lepraliella* for this and the following species.

Lepraliella hippopus (Smitt).

Lepralia, Smitt, 1867; Lütken, 1875; Vanhöffen, 1897; Bidentkap, 1905; *Eschara*, Norman, 1906.

Hippoporina pertusa (Esper).

Lepralia, Kirchenpauer, 1874; Hennig, 1896; Vanhöffen, 1897; *L. nordlandica*, Kluge, 1907. The species has commonly been known as *Lepralia pertusa*.

Monoporella spinulifera (Hincks).

Mucronella, Bidenthap, 1905.

Cheilopora sincera (Smitt).

Discopora, Smitt, 1867; Lütken, 1875; *Lepralia*, Hincks, 1877; *Hemeschara*, Busk, 1881; *Lepralia*, Hennig, 1896; *Mucronella*, Vanhöffen, 1897; Bidentkap, 1905; Kluge, 1907.

Hemicycloporella potita (Norman).

Lepralia emucronata, Kluge, 1907.

Cellepora surcularis (Packard).

Celleporaria incrassata, Smitt, 1867; *Cellepora incrassata*, Kirchenpauer, 1874; *Celleporaria incrassata*, Lütken, 1875; *Cellepora incrassata*, Hincks, 1877; *C. cervicornis*, Busk, 1881; *C. incrassata*, Hennig, 1896; Vanhöffen, 1897; Bidentkap, 1905; Norman, 1906; Levinsen, 1916.

Cellepora tuberosa (d'Orbigny).

C. ramulosa forma *tuberosa*, Smitt, 1867.

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Article XX.—MAMMALS COLLECTED IN EASTERN CUBA IN
1917. WITH DESCRIPTIONS OF TWO NEW SPECIES

BY H. E. ANTHONY

PLATES XXXV TO XXXVII

Early in 1917 work was begun in the eastern end of Cuba, the Santiago region, with the intention of making collections of the living mammals and of exploring as many caves as possible in the search for extinct mammalia. I was able to get well started, with enough data gathered from various sources to insure a successful expedition, when the political rebellion that caused so much trouble in Cuba broke out. It found Mrs. Anthony, who was my able assistant on this expedition, and me at Daiquiri investigating the caves along the seacoast; and developments of this disturbance so interfered with our movements that we were compelled to remain here for several weeks after my work had been practically finished. Upon being able to get out to Santiago I learned that it was useless to attempt further work in this part of the island that spring and consequently gave up my plans and returned to New York City.

Subsequently, the entrance of the United States into the World War, when I left the Museum to enter military service, not only prevented a return to Cuba to follow up the clues I had obtained in 1917 but even kept me from a very close examination of the collection that had been made. A preliminary investigation, however, disclosed a new fossil bat, which was described.¹ Now that this material has been more fully looked over, it proves to be well worthy of putting on record.

After my return from Cuba in 1917 I was able, thanks to the courtesy of Mr. William Palmer of the United States National Museum and of Dr. G. M. Allen of the Museum of Comparative Zoology, to look over the collections made on the western end of Cuba that same spring by the National Museum and by Dr. Thomas Barbour of the Museum of Comparative Zoology. In addition to these collections I have seen material collected on the Isle of Pines by the Messrs. Link and brought to the American Museum for identification by Mr. O. A. Peterson of the Carnegie Museum. The species taken thus in four different collections are, so far as is now known, nearly identical; that

¹1917, *Bull. Amer. Mus. Nat. Hist.*, XXXVII, p. 337; May 28.

is to say, a genus occurring on both ends of the island is represented by the same species at each end and there seems to be no apparent differentiation over a large range. I exclude from this statement the species of *Nesophontes* described in this paper; *Nesophontes micrus* is found at both ends of the island and further research may show a similar range for the new form.

I take pleasure in acknowledging the very material assistance rendered the expedition to Cuba by many individuals. Mr. William Fromm of Santiago, through his intimate knowledge of the region, was able to give me much valuable information and to put me in touch with many persons who could help the expedition, and to him my sincerest thanks are due. Mr. Whittaker, in charge of the Spanish American Iron Mines, placed quarters near Daiquiri at my disposal and gave me valuable assistance in many ways. Mr. Charles Ramsden, of Guantanamo, Cuba, presented me with several specimens of rare bats from his own collection and also stood ready to help the work in the field had it not been summarily cut off. I wish also to acknowledge my appreciation of the keen interest and material aid given by Dr. W. D. Matthew of the Department of Palæontology of this Museum, one of the pioneers in the attack on the West Indian problem.

Almost all of our collecting was done in the vicinity of Daiquiri, on the eastern coast of Cuba. Commencing work at Santiago, I made a short two-day trip back into the mountains to Jarahueca, near Sabanilla, but failed to find anything in the caves there to warrant a return. A reconnaissance at Daiquiri disclosed localities well worth extended investigation and, having been joined at Santiago in the meantime by Señor Victor Rodriguez, who was kindly sent to my assistance by Dr. Carlos de la Torre of the University of Havana, I moved our base to Daiquiri where we were very courteously received by Mr. Serrano, the superintendent of the iron mines operated by the Spanish American Iron Co., who made us his guests at his own house. Working conditions at Daiquiri proved to be ideal, as we could ride to and from the caves on the railroad of the mines and the cliffs along the Daiquiri sea-front are honeycombed with caves (Plate XXXV, fig. 1). At first I was able to carry a gun and planned to collect *Capromys* and as many of the living bats as possible. With the outbreak of the rebellion I had to abandon this as all guns were confiscated and only such bats as could be netted or knocked down by branches were secured.

While a number of caves had a few bones in them, only two caves had large deposits. One of these, a small cavern high up on the side of

the limestone hill that overlooks the roadstead of Daiquiri, was worked in less than a day but the other was not left until after many days work of two or more people. The earth in the small cave was very red and the bones were strongly impregnated with this pigment, probably an iron stain.

The larger cave, the one known as the "Cueva de Los Indios" (Plate XXXV, fig. 2; Plate XXXVI, fig. 2), contained earth dark brown in color, loose and light in texture, and formed partly from decomposed limestone but more largely by bat guano, long since returned to its mineral constituents. The part of the cave where we worked is a small part of what was formerly a much larger underground chamber (Plate XXXVI, fig. 1), the roof of which is today fallen in, leaving a great open center in which several large trees are growing. There are two main entrances to this central court and the one we climbed up has two mouths. The whole cave in its greatest extent is about 150 by 60 feet. In these main features it bears considerable resemblance to the "Cueva Catedral" of Porto Rico, where I found a similar rich bone deposit; and I believe that it is more than mere coincidence that bones are found in greatest abundance in the large caves where the top has fallen in, admitting light, and where there are several entrances.

Throughout most of the area covered by the former cave extension the rains have washed out the earth and it is impossible to determine what was there before the roof fell in. Great masses of limestone from the roof fill the central opening and further obstruct investigation. Small subchambers opening into the central court yielded nothing to preliminary excavations. The principal bank of earth was a low rounded mound (Plate XXXVI, fig. 2), approximately forty feet long and twenty-five feet wide, sloping uniformly from the side wall of the cave down to the cave floor. It was probably the remains of a huge guano pile with a certain admixture of earthy material from the limestone walls. The bones were found quite uniformly in a stratum of about twelve inches thickness. In this stratum there were local areas of concentration where there was little else but hundreds of small bones. Specimens were found from the top down and, although some of these at the surface were *Epimys*, *Artibeus*, and other living species, being of quite recent deposition, most of them were of an older period and were found right through to the bottom of the layer. It appeared as if some agency had removed a little of the upper surface and thus exposed these bones, since they were very dark in color and had evidently been buried beneath the soil for some time. This agency may have been the wind or rain, as, although

the roof of this portion of the cave overhangs about forty feet beyond the mound, it is high enough to leave the mound exposed.

Judging from the deposits of rat and bat remains being laid down at the present time in this cave by the Cuba Barn Owl, in some places already forming deposits of considerable extent, we have the key to the accumulation of the extinct mammalia in the mound. Another point in favor of this theory is the scarcity of complete skulls but the abundance of lower jaws and palates. The owl breaks open the skull to eat out the brains and afterward swallows the mammal entire, if it be a small one, the passage of the bones through the digesting action of the owl's stomach accounting for the very fragile nature of the bones.

On the opposite side of the cave a bone-bearing breccia was discovered. This lay in a bed varying from four to eight inches in thickness, reposing in a rather even plane which tilted decidedly toward the middle of the cave. The bed rested upon the original limestone but in many places it met the limestone only at points here and there and thus arched over, being easily broken up in consequence of this type of support. The breccia is full of the same species as were found in the mound, with the obvious exception of *Epimys*, and must have been contemporaneous in its formation with the mound. The breccia abutted against the wall at about the same height as the mound and was coated over by a thin flow of limestone evidently deposited from solution. The formation of this type of breccia is undoubtedly very rapid.

I put a man with a shovel to work at trenching through the mound, clear down to the rock floor, to learn how deep the bones went. He struck a hard formation at about two feet and extensive digging showed that the deeper layers carried no bones.

The age of the Cuban fossils must be, comparatively speaking, very recent. In my opinion, the late Pleistocene is the earliest time in which a conservative judgment can place them, while the evidence seems to favor the age of the specimens as being of the early Recent era.

As it is a labor of many days to thoroughly work over the many thousand limb bones and skeletal remains collected, a detailed report is given of the skulls only, leaving to some future paper the treatment that this mass of material deserves.

***Capromys pilorides* (Pallas)**

I [*sodon*] *pilorides* SAT, 1822, Journ. Acad. Nat. Sci. Philadelphia, II, p. 333.

Although going to Cuba with every intention of securing a large series of *Capromys*, the prohibition on the use of fire-arms prevented me from carrying out this plan and only five specimens were secured.

These five specimens are all immature animals, three of them less than half grown, the other two nearly the full dimensions, in external measurements, of a normal adult but with skulls much smaller than in adults taken at Trinidad, Cuba. A number of discrepancies noted in comparing this series with typical *pilorides* from Trinidad are attributed to age but I do not have enough material at hand to satisfy myself that such is really the case. The Daiquiri skins have the hind feet whitish on the upper side (blackish in the Trinidad series); the tail is whitish (yellow or ochraceous in the Trinidad series); and the skulls are notably wider in proportion to their length than is the case with the Trinidad specimens, one of which, moreover, seems to be comparable in age with my oldest specimen.

The only hunt that I was able to make for "Hutias" was in patches of forest near Daiquiri. This growth was not the primitive jungle but was sufficiently dense to make travel slow and difficult. I had a native guide who knew where to seek the animals and I shot two of them in the course of the morning. I was told that the Hutia climbs into the top of some tall tree and curls up for a sun bath early in the morning. The best way to hunt them is to get out when the sun is yet low and move quietly through the forest scanning closely every tall tree. Both animals that I saw were detected high up in leafy trees, where they were curled up on limbs and were not easy to distinguish from clumps of foliage.

I was told that Hutias were common about Daiquiri and the natives thought that there was more than one kind in the region but, although I offered to buy specimens, I secured only three more. The natives usually hunt this animal with a small dog which scents the Hutia in the tree above him and bays the animal; or sometimes he surprises it on the ground and chases it into a hole in the rocks.

***Capromys nana* G. M. Allen**

Capromys nana G. M. ALLEN, 1917, Proc. New England Zool. Club, VI, p. 54.

This small *Capromys* is represented by more than three hundred mandibles, about half of which have two or more teeth, and some sixty skull fragments, only five or six of which are more than mere palates.

This material agrees well with the description and figures of *nana* given by Dr. G. M. Allen, *loc. cit.*, and Dr. Allen kindly compared for me specimens which I sent him, pronouncing them to be *nana*. It would have been not at all strange if the Eastern Cuba specimens had proved to be distinguishable from *nana* found in Central Cuba but my

material is rather too incomplete to formulate a conclusive statement on this point. Certainly no characters of separation exist in the mandible and palate alone.

The discovery of *nana* as a living mammal in Central Cuba warrants the suspicion that it may be found alive in the Oriente of Cuba as well, but this fact I very much doubt. Since none of my specimens appear to be at all recent and since this mammal formed such a large part of the owl diet in times gone by, it would almost certainly appear in recent owl pellets no matter how rare the animal might be.

***Geocapromys columbianus* (Chapman)**

Capromys columbianus CHAPMAN, 1892, Bull. Amer. Mus. Nat. Hist., IV, p. 314.

Among quite a mass of capromid material collected at Daiquiri, nearly half of the specimens are referable to *Geocapromys*. By far the greater part of the material is composed of mandibular rami of which more than two hundred and twenty-five have been examined, while the cranial fragments are mainly palates, lacking teeth, of which there are about forty that may be satisfactorily identified.

Practically all of this material is evidently from young and very young animals. None of the specimens are as large as the type specimen of *columbianus* or specimens collected by Mr. Barnum Brown near Cienfuegos. The owls doubtless did not prey upon the full-grown *columbianus* and brought only small, immature animals to the cave. Because of the small size of the remains, they are not easily separated from *Capromys nana* unless the fragments are large enough to show several characters.

Mandibles containing the premolar are at once identified by the extra internal reëntrant, nearly always well developed but occasionally approaching the condition seen in rare cases among *Capromys* where the extra reëntrant appears as little more than a slight indication of the normal angle. Also, the rather evident immaturity shown by the rami enables small *columbianus* to be distinguished from *C. nana*, while the character of the alveolar margin of the last molar, the slope of the enamel plates of this tooth, and the oblique position of the teeth in respect to a horizontal plane (more nearly at right angles in *Capromys*) are confirmatory characters.

In working over the palates I have noted a very important character which I have not seen mentioned in the literature on these rodents but which I have found to be most valuable as a basis of separation between *Capromys* and *Geocapromys*. In *Capromys* the upper incisor takes its

origin very near to that of the first upper premolar and the two alveoli nearly meet; there is scarcely any swelling on the maxillary to show the course of the incisor. In *Geocapromys* the course of the incisor is clearly shown on the face of the maxillary as a prominent swelling and its upper termination is high up on the wall of the anteorbital foramen, very much higher than is the case in *Capromys* where it is sunk into the zygomatic root. This character is constant among recent as well as fossil species and is especially useful when only scraps of the palate are compared, since enough of the maxillary is generally present to show this point.

None of the specimens appear to be very recent; all are very much stained; and the association shows that *G. columbianus* was contemporaneous with *C. nana* throughout the limited horizon explored.

***Boromys ofella* Miller**

Boromys ofella MILLER, 1916, *Smithson. Misc. Coll.*, LXVI, No. 12, p. 8; December 7.

As noted in the remarks under *B. torrei*, this species was found very sparingly. The scanty material at hand appears to agree well with the type description of *ofella* and with material collected by Dr. Barbour farther to the west. The type locality of *ofella* is Baracoa and Daiquiri is less than one hundred miles distant in the same character of country so that it would be rather surprising should the large species of *Boromys* from Daiquiri prove to be anything other than *ofella*.

***Boromys torrei* G. M. Allen**

Boromys torrei G. M. ALLEN, 1917, *Bull. Mus. Comp. Zool.*, LXI, No. 1, p. 6.

A great abundance of fragmentary material of this genus was found in caves at Daiquiri, by far the most of it coming from the Cueva de Los Indios. Some idea of the abundance of the members of this genus is shown by the fact that I have cleaned and examined over five hundred mandibular rami, while nearly as many fragments have been ignored as too badly broken up. The small *torrei* seems to have been the dominant form, as only about five per cent of this series represents the larger *B. ofella*. To go with these rami, there are eight skull fragments which, in the aggregate, show nearly all the characters of a perfect skull.

A great range of variation in dental pattern is shown by this series, which discloses about every stage of wear from the freshly erupted molar to the tooth that has the crown nearly worn to the roots. Coincident with the amount of wear, the crown pattern changes from a series of

external and internal reëntnants to a series of enclosed lakes, two in each tooth, placed side by side and not in an anteroposterior line. In very early stages of wear there are two internal reëntnants in the lower molar series but the most posterior of these soon disappears, passing into a lake which has worn away by the time the two main reëntnants have worn to form the laterally placed lakes. In the lower premolar an anterior lake is present in the unworn tooth but does not persist for any great length of time. The pattern at full maturity is a figure eight with no lakes, either anterior or posterior, although individuals that should be properly included in this category may show a trace of the posterior lake, where it persists longer in m_1 and m_2 . The accessory internal reëntnant does not seem to be as well developed in *torrei* as in *ofella*.

A correspondingly shifting molar pattern is to be noted in the upper dentition, where the accessory reëntnant is external and the first lake to be seen is a posterior one.

Like the Spiny Rats, the Cuban *Boromys* assumes the appearance of a mature animal while yet only about half to two-thirds grown; and, while this condition may often be detected if the material is adequate, when only fragments of skull or rami are obtained the question of determination becomes complicated. The differences between *torrei* and *ofella*, the best character of separation being size, are readily apparent and no difficulty is experienced in separating the material into two series to correspond. However, the type of *torrei* was found in the Province of Matanzas, over 400 miles from the Santiago region where my material was found, and it is not unreasonable to expect *Boromys* from the two places to differ; but a comparison of the Oriente material with specimens in the Museum of Comparative Zoology from farther west fails to disclose any noteworthy differences.

***Nesophontes micrus* G. M. Allen**

Plate XXXVII, Figures 6, 7, 8, 9, 11, 12

?*Nesophontes micrus* G. M. ALLEN, 1917, Bull. Mus. Comp. Zool., LXI, p. 5.

This small insectivore is represented by some thirty-three skulls and one hundred and fifty mandibles, most of the former being rather fragmentary but a number of the latter being perfect, except that none of the mandibles contain a complete set of incisors.

Most of this material is stained and very dark brown, although there are a few rami that are very recent in appearance. The *Nesophontes* material is associated with the *Geocapromys* and *Boromys* and was found

from almost on the surface down to about two feet, where the bone-bearing earth played out. Having before me extensive series of both the Porto Rico and the Cuba insectivores, I have made a detailed comparison of the two with the view to satisfying myself that they are congeneric. This I have been able to do and I agree with Dr. G. M. Allen that the species *micrus* is a good *Nesophontes*. For convenience in comparison I append the following table of characters by which the two forms differ.

<i>N. edithæ</i>	<i>N. micrus</i>
General outline of skull, viewed from above, from parietals to tip of nasals, subrectangular.	This outline often subtriangular; possibly this applies only to females.
Constriction of brain-case at occipital region moderate.	Constriction averaging greater, parietal more bulging.
Lateral face of premaxillary flat.	Premaxillary with a shallow lateral concavity, more or less pronounced.
Anteorbital border of maxillary rounded.	Maxillary with a thin shelf-like expansion on orbital border.
Lachrymal foramen small, the opening simple.	Lachrymal foramen large, actually as large as in the larger species, <i>edithæ</i> , and expanded into a trumpet-shaped opening.
Anterior upper premolars equal in size.	First anterior upper premolar noticeably larger than second.
Lower premolars of equal size, crowded in the tooth-row, obliquely overlapping each other.	Second lower premolar about half the size of the other two, premolars not crowded or overlapping.
Lower molars extending externally beyond margin of alveoli.	Lower molars not extending so far beyond margin of alveoli.

In all other characters *edithæ* and *micrus* agree and, although the differences are at once discernible and of rather a pronounced character, I believe that they are only such as should mark a good species and are not worthy of even a subgeneric split. The size difference between the two sexes is not as well shown in the Cuban series as it is in the Porto Rican *Nesophontes* but is apparent nevertheless.

***Nesophontes longirostris*, new species**

Plate XXXVII, Figures 10, 13

Type, No. 17626, Dept. of Vertebrate Palæontology, from a cave near the beach at Daiquiri, Cuba, Feb. 1917; collector, H. E. Anthony. The type is the anterior portion of a skull, from the auditory region to the tips of the nasals being almost perfect; the dentition is complete except for the incisors on both sides. The skull is a light brown in color and was thinly encrusted with a calcareous cement.

GENERAL CHARACTERS.—Very similar to *Nesophontes micrus*, but rostrum proportionally more slender and space between upper canine and the last premolar much greater than in *micrus*; the two anterior premolars subequal in size and with distinct diastemata between the canine and the first premolar, between the two anterior premolars and between the second and third premolars of the row.

DETAILED DESCRIPTION.—Skull narrow and elongate, presenting all of the characters of *micrus*, but the rostrum very long and slender; interorbital region parallel-sided, with frontals rounded and somewhat inflated; nasals very narrow; premaxillæ with slight concavities along the nasal suture and meeting the nasals at almost ninety degrees, instead of a gradual rounded transition into the nasal region as in *Nesophontes edithæ*; anteorbital border of maxillary expanded into a thin shelf that is continued about the lachrymal foramen to form a large trumpet-shaped opening; palate long and narrow, interior margins of tooth-rows nearly parallel; pterygoids long and inflated to tube-like proportions.

DENTITION.—Dentition essentially that of typical *Nesophontes*, the canine tall and sharp, two-rooted; first two premolars simple and nearly equal in size, scarcely half as tall as the third premolar which is submolariform in shape with a very high piercing cusp and a notch-like shoulder on the anterior cingulum; first two molars of equal size with well-developed protocone and metacone, the paracone being almost vestigial in comparison and smaller in the second molar than in the first; third molar about half the size of the first two and lacking a high metacone; between the canine and the first premolar there is a distinct separation, with separations of equal extent between the first and second and the second and third premolars, resulting in the distance from the canine to the third premolar being much longer than in *micrus*.

It will be seen from the measurements that *longirostris* is a longer and slenderer form in its proportions than *micrus*. Because of the fragmentary nature of the material, some unusual measurements had to be taken but they serve to show that the new form varies consistently from *micrus*. Although as long or longer than males of *micrus* in most proportions, in breadths *longirostris* is as narrow as the females, while in the character of the separation of the canine and last premolar it is unapproached by any of the series of *micrus* and quite exceeds a large male of *edithæ*. It is impossible to be sure whether the type represents a male or a female, although it might be argued from its slender structure that when more of the skulls with separated premolars are found there will be individuals conspicuously heavier in structure than the type. If so, these individuals will doubtless be noticeably larger than *micrus*, judging from the apparent sexual variation in the series of *micrus* and *edithæ*.

The spacing of the premolars in *longirostris* would appear to be rather an important character, in view of the fact that (1) there is so little variation in the dentition shown by the very large series of *N. edithæ* and the fairly large series of *N. micrus*, and (2) the differences between the two species are remarkably constant when everything is

considered. A search among the one hundred and fifty mandibular rami of Cuban *Nesophontes* fails to reveal one with a corresponding spacing of the lower premolars.

MEASUREMENTS

	<i>micrus</i>	<i>longirostris</i>	<i>edithæ</i>
Length from glenoid fossa to alveolus of first incisor.	No. 17627—18.8 ♀ 17628—19.7? ♂ 17629—19.0? ♂ 17630—.... ♂ 17631—20.8 ♂ 17632—19.3 ♀	No. 17626—21.3 (Type)	No. 17095—29.2 ♂ 14174—27.0 ♀ (Type)
Length of palate, postpalatal notch to alveolus of first incisor.	17627—13.2 ♀ 17628—14.1? ♂ 17629—14.2? ♂ 17630—14.5? ♂ 17631—15.3 ♂ 17632—13.7 ♀	14.7	20.5 ♂ 19.2 ♀
Breadth across maxillary zygomatic roots.	17627— 9.9 ♀ 17628—11.5 ♂ 17629—10.7 ♂ 17630—10.9 ♂ 17631—11.8 ♂ 17632—10.8 ♀	10.6	16.5 ♂ 14.6 ♀
Breadth of rostrum at canines.	17627— 4.1 ♀ 17628— 5.0 ♂ 17629— 4.2 ♂ 17630— 4.5 ♂ 17631— 5.1 ♂ 17632— 4.0 ♀	4.4	7.5 ♂ 6.4 ♀
Breadth of palate across m ¹ .	No. 17627— 7.8 ♀ 17628— 8.5 ♂ 17629— 8.2 ♂ 17630— 8.1 ♂ 17631— 8.4 ♂ 17632— 7.5 ♀	7.8	12.1 ♂ 10.4 ♀
Depth of rostrum, vertical distance at m ¹ .	17627— 6.3 ♀ 17628— 7.6 ♂ 17629— 7.4 ♂ 17630— 6.5 ♂ 17631— 7.7 ♂ 17632— 6.2 ♀	6.5	10.0 ♂ 9.2 ♀

	<i>micrus</i>	<i>longirostris</i>	<i>edithae</i>
Distance from glenoid fossa to maxillary zygomatic root.	17627— 6.1 ♀ 17628— 7.1 ♂ 17629— 7.0 ♂ 17630— ... 17631— 7.6 ♂ 17632— 6.3 ♀	No. 17626— 7.6 (Type)	No. 17095—11.7 ♂ 14174—10.5 ♀ (Type)
Length of maxillary tooth-row, canine to m ³ .	17627—10.6? ♀ 17628—12.0? ♂ 17629—11.6? ♂ 17630—11.8 ♂ 17631—11.7? ♂ 17632—11.1 ♀	12.0	16.2 ♂ 14.9 ♀
Distance from canine to last premolar, posterior border of canine to anterior border of premolar.	17627— 2 ♀ 17628— 2 ♂ 17629— 2.6 ♂ 17630— 2.6 ♂ 17631— 2.2 ♂ 17632— 2.2 ♀	3.2	2.8 ♂ 2.7 ♀

Noctilio leporinus mastivus (Dahl)

Vespertilio mastivus DAHL, 1797, *Skrivter. af Naturhist.-Selskabet Kjøbenhavn*, IV, p. 132.

A fragment of a right mandible, containing the last two molars, proves upon comparison with the mandible of a female from Porto Rico to be unquestionably of this species. This is the only record for *Noctilio* that I secured and it was found in a cave at the top of a low hill looking out over the sea. The mandible is stained a deep red and was in the formation with *Nesophontes* and *Boromys*.

Chilonycteris parnellii boothi (Gundlach)

Chilonycteris boothi GUNDLACH, 1861, *Monatsber. k. preuss. Akad. Wissensch., Berlin*, p. 154.

This bat was not secured in the flesh nor was it noted alive in any cave, but a skull was picked up on the floor of a small cave at Daiquiri. The skull is white and not discolored in any way, from which fact I should expect to find this species inhabiting some of the many caves of this region.

***Macrotus waterhousii minor* (Gundlach)**

Macrotus minor GUNDLACH, 1864, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 382.

In the deposits at Daiquiri I found five skulls and ten mandibles of this species as fossils. Additional material was found in fresh owl pellets but the fossil material is all old and dark brown in color. In no way do these specimens differ from the bat now living there.

Forty-three specimens of the living *Macrotus* were collected as follows: Daiquiri, 11 skins, 10 alcoholics; Jarahueca, 15 alcoholics; Siboney, 2 skins, 5 alcoholics.

This series presents the two color phases described by Rehn in his revision of the genus¹ but these two types of coloration in their relation to sex are difficult to determine; although the brightest colored specimens are males, some of the females are ferruginous in color. None of the ferruginous phase have the "hair unicolor" as given by Rehn. Four females taken March 2 had large embryos; three taken March 7 had small embryos.

Macrotus is a very common bat in eastern Cuba and was noted in most of the caves where the chambers were well darkened.

***Monophyllus cubanus* Miller**

Monophyllus cubanus MILLER, 1902, Proc. Acad. Nat. Sci., Philadelphia, p. 410.

Only one specimen of this species was collected and this constitutes the sole positive record I secured. This specimen was taken at Jarahueca near Sabanilla, in a cave among the hills. In several of the larger caves about Daiquiri I saw small bats that may have been *Monophyllus* but the caves were too high to collect with a net and without a gun I could not verify my observations. It seems very probable that this species is not generally distributed on the eastern end of the island or more would have been taken.

***Brachyphylla nana* Miller**

Brachyphylla nana MILLER, 1902, Proc. Acad. Nat. Sci. Philadelphia, p. 409.

Although *Brachyphylla* was not found living in any of the caves visited, a good series of fossil skulls was secured. Every one of the crania is discolored by age but a few of the mandibles are white and quite fresh, showing that this bat is occasionally to be found frequenting

¹A Revision of the Mammalian Genus *Macrotus*, 1904, Proc. Acad. Nat. Sci. Philadelphia, p. 463.

this region. The material comprises sixty-six skulls, only three of which are at all complete and these are without teeth, and sixty mandibular rami, of which twelve are perfect but lacking teeth in most cases.

Upon looking up the specimens of Cuban *Brachyphylla* in the American Museum, I discovered that a series collected at Santiago in April 1902 and labeled as *cavernarum* are in reality *nana*. This series contains twenty alcoholic specimens and six of the skulls have been removed and cleaned for study. This material affords an excellent basis for comparison with the fossil series, which agrees well with the animal now living on the island. Not one specimen among the entire series seems to be referable to *cavernarum*, from which *nana* is readily distinguished by size alone. In addition to the characters pointed out by Miller¹ as separating these two species, namely the difference in size and the extent of the postpalatal notch, it is to be noted that there is a slight difference in the development of the last upper molar. In *cavernarum* this tooth has an anteroposterior breadth nearly equal to the lateral breadth, but in *nana* the tooth is relatively narrower in the line of the tooth-row, in most of the skulls.

Compared with a large series of fossil *cavernarum* from Porto Rico the size difference is sufficient to separate the Cuban series without difficulty, although there is a tendency in the Porto Rican specimens for the skull to be a trifle smaller than in the bat now living there. The character of the differences separating these two species is such that I believe *nana* will stand eventually as a subspecies of *cavernarum*, when more material has been secured and the range of the genus is better understood.

***Artibeus jamaicensis* Leach**

Plate XXXVII, Figures 1, 2

Artibeus jamaicensis LEACH, 1821, Trans. Linn. Soc. London, XIII, p. 75.

Among the lot of *Artibeus* material taken fossil are several skulls and a mandible of a race or perhaps species quite noticeably larger than *jamaicensis parvipes*. The skulls are fragmentary, being the anterior portions, some of which contain several molars, and have been encrusted with lime. This lime may or may not signify a greater antiquity, since all of the other skulls of *Artibeus* were in a loose earthy formation and had not become cemented. Because of the fragmentary nature of this material, taken in conjunction with the closely intergrading characters

¹1902, Proc. Acad. Nat. Sci. Philadelphia, p. 409; September 12.

of the *jamaicensis* group, I have been unable to allocate satisfactorily these specimens. It is certain that they do not represent *parvipes* since they are conspicuously larger and more massive, with heavier teeth, in all these characters closely approaching typical *jamaicensis* (Plate XXXVII, figs. 1-5). On the other hand, these characters apply as well to *j. yucatanicus* and the possibilities of distribution serve for the one as well as the other. It would not be unreasonable to suppose that these specimens represent the earlier ancestral form of *parvipes*, but for the fact that the number of fossil skulls of *Artibeus* from Daiquiri indicates that the intergradation between the large specimens and the smaller, normal *parvipes* is rather abrupt. The not inconsiderable amount of variation in the *parvipes* series does not produce a skull truly comparable to this large form, the principal measurements of which are as follows.

Breadth of palate across alveoli of m², 12.7 mm. (*parvipes*, 11.6 mm.); interorbital breadth, 7.4 and 7.3 mm. (*parvipes*, 6.7 mm.); greatest breadth of m², 3.8 mm. (*parvipes*, 3.6 mm.); greatest length of mandible, 19.6 mm. (*parvipes*, 18.8 mm.).

Judging from the conclusions reached by Dr. Knud Andersen in his monograph on *Artibeus*,¹ it would be decidedly unwise to attempt to base far-reaching conclusions upon such scanty material and the best treatment seems to be to consider this large form as *jamaicensis* in the broad sense.

***Artibeus jamaicensis parvipes* (Rehn)**

Plate XXXVII, Figures 3 to 5

Artibeus parvipes REHN, 1902, Proc. Acad. Nat. Sci. Philadelphia, p. 639.

Upwards of ninety skulls and one hundred and fifty mandibles of this bat were found fossilized in the caves about Daiquiri. Practically all of this material is discolored and fully as ancient as the specimens of *Nesophontes* and *Boromys* with which it was found associated.

The individual variation disclosed by this series and by a few skulls picked up from nearest bone deposits, mainly from owl pellets, is very apparent. One of the principal characters of variation is the size and shape of the rostrum, correlated with a less noticeable variation in the size of the entire skull.

This species is a common bat, living in the caves throughout the eastern end of the island. It was seen in the caves visited near Sabanilla and was found in a number of caves from Aguadores to Daiquiri.

¹1908, Proc. Zool. Soc. London, pp. 204-319; September.

Specimens were taken as follows: Daiquiri, 14 skins, 4 alcoholics; Jarahueca, 13 alcoholics.

The series presents few features worthy of comment. The coloration is rather uniform throughout the series but there are two individuals somewhat lighter than the others.

Each of eleven females collected March 7 contained a single large embryo, some of them nearly ready for birth.

***Phyllops falcatus* (Gray)**

Arctibeus falcatus GRAY, 1839, Ann. Nat. Hist., IV, p. 1.

This rare species is represented by seven fragmentary skulls and four mandibular rami collected at Daiquiri. The animal was not found alive. In addition to this small series, I have an almost perfect skull taken from an owl pellet collected by Mr. Barnum Brown, of the Department of Vertebrate Palæontology of this museum, at the "Cueva de Los Machos" near Cienfuegos.

Compared with a skull taken from an alcoholic specimen (No. 123187, U. S. N. M.) collected at Santiago and kindly loaned me by Mr. Gerrit S. Miller, Jr. of the National Museum, this series of subfossil skulls shows considerable differences. None of them are as large as the Santiago specimen and there are minor variations in the breadth, extent, and shape of the postpalatal notch. None of the series, however, intergrade with *P. vetus*, from which they may be readily distinguished by their larger size, the more V-shaped postpalatal notch, and by the absence of the deep basioccipital pits, this latter character alone sharply separating the two series.

The material of *falcatus* is, for the most part, fresh in appearance and not deeply discolored, some of it very recent in fact.

***Phyllops vetus* Anthony**

Phyllops vetus ANTHONY, 1917, Bull. Amer. Mus. Nat. Hist., XXXVII, p. 337.

I have very little to add to my original description of this species, *loc. cit.*, except that, having gone over the entire collection of cave material more thoroughly than I had done at that time, I am able to confirm the impression that *vetus* is an older form than *falcatus*. The finding of specimens of *falcatus* in the cave material has drawn attention to the fact that the specimens of *vetus* are all more ancient in appearance, more deeply stained and discolored. The totality of bat species brought in by the owls is so much greater than the number of species I observed

personally that I have come to regard the owl as an exceedingly efficient collector. Consequently, if recent remains of a form are not found in the deposits made by the owls, the odds are greatly against that form being found alive in that particular region.

***Phyllonycteris poeyi* Gundlach**

Ph[yllonycteris] poeyi GUNDLACH, 1861, Monatsber. k. preuss. Akad. Wissensch., Berlin (1860), p. 817.

This species is represented by twenty-three skulls, five of which are only slightly broken, and five mandibles, all of which were found in the deeper layers of bones and are all brown and ancient-looking. Compared with skulls of *poeyi* taken at Guanajay, no differences worthy of note can be detected.

This bat was not found living in any of the caves.

***Erophylla sesekorni* (Gundlach)**

Phyllonycteris sesekorni GUNDLACH, 1861, Monatsber. k. preuss. Akad. Wissensch., Berlin (1860), p. 818.

A large series of forty-one skins and eight alcoholics of this rare bat was taken in a cave near Siboney. Formerly a very rare species, its recent rediscovery has shown that it is common locally and I found that to be the case about Siboney.

About two miles from Siboney on the railroad to Santiago, a faint trail takes off to the right through the low brush and leads up to a small opening in the mass of limestone that forms the low ridge parallel to the sea-front. This entrance is the opening to a large and fairly high chamber with a number of smaller side chambers, so low that often one can not stand erect in them. This cave is the home of many hundreds of *Erophylla* and they seem to have the cave entirely to themselves. Being unable to use the shot-gun, I was forced to have recourse to primitive collecting methods. The bats were congregated in large numbers in the small subchambers and I entered these, going through the small openings on my hands and knees. Once inside, I would lay wildly about me with a handful of switches, trusting to be able to knock down some bats because of their number in such close quarters. In this I was successful and, by following them from chamber to chamber and repeating the process, I was able in two visits to the cave to obtain this large series. It would be hard to find a more exhausting way to collect bats; the violent exertion in the close air of the cave brought forth the perspira-

tion in torrents and left me completely used up at the end of half an hour. At my second visit to the cave, the number of bats to be seen was very noticeably less and it may be that this species leaves a cave completely when too closely harassed.

The series is about evenly divided between the two sexes, and small embryos were found in eleven of the females, taken February 26 and 28. The coloration of the entire series is remarkably uniform.

Compared with a series of *Erophylla bombifrons* from Porto Rico, there are no apparent differences in color between selected individuals but the average coloration of *bombifrons* is darker. The forearm of the Porto Rican bat is a trifle longer, about three millimeters, the ear is shorter and broader, with a more deeply notched tragus, the tragus of *sezekorni* being much longer.

An examination of the skulls of this series reveals the rudimentary condition of the zygomatic arch. Never more than a mere thread of bone at a mid-point, in two specimens the arch is incomplete and the uniform appearance of the gap, the same on both sides, shows that it is not an accidental break.

Natalus primus, new species

Type, No. 41009, Dept. of Mammalogy, Amer. Mus. Nat. Hist., Daiquiri, Cuba, February 1917; collector, H. E. Anthony. The type is the right mandibular ramus with the last two premolars and all of the molars in position; a topotype mandible contains the last premolar and the first molar.

CHARACTERS.—A very large *Natalus*, with long slender mandible and heavy teeth.

MEASUREMENTS.—Greatest length, 14.4 mm.,¹ 14.6, (13.6)²; depth of mandible at m₁, 1.5, 1.4, (1.4); transverse breadth of m₁, 1.1, 1.1, (.9).

From *Chilonatalus* and *Nyctiellus*, the only ones of the *Natalidae* hitherto known from Cuba, *Natalus primus* is easily separated by the great difference in size. From *Natalus major*, the largest of the group, it may be known by its even greater length of mandible and noticeably heavier teeth. The first lower molar is especially "plump" in contour and the tooth extends externally considerably beyond the alveolar border.

These mandibles were found associated with *Nesophontes* and *Boromys* in the Cueva de los Indios at Daiquiri, buried but a short distance under the surface. The bone is stained a very dark brown and

¹First measurement given is that of type, second of topotype.

²Measurements of type mandible of *Natalus major* Miller, kindly loaned me for comparison by Mr. Gerrit S. Miller, Jr. of the United States National Museum.

probably represents an extinct form. This is a northward extension of the genus in the West Indies and doubtless is the Cuban representative of the same ancestral stock from which the Santo Domingan *major* developed.

***Molossus tropidorhynchus* Gray**

Molossus tropidorhynchus GRAY, 1839, Ann. Nat. Hist. IV, p. 6.

A mandible with a molar and two premolars is the only fossil record of this species found. A skull found in one of the caves came from the uppermost layer and is doubtless not very ancient to judge from its appearance. No variation from the living form can be detected in the fossil.

• A small colony of *Molossus* was found in a small fissure that opened out on the exposed face of the sea-wall. Their presence was detected by droppings at the foot of the wall and when a shot was fired into the crevice several of the bats flew out but only one was secured. A later attempt to climb up to the crevice proved fruitless since the animals had departed, probably driven away by my previous disturbance. A small, free-tailed bat was seen nightly, flying about the hillsides near the superintendent's quarters, but as I did not dare shoot for fear of having my gun confiscated I could not be certain as to its identity. As I did not take *Nyctinomus* at Daiquiri these bats were very probably *Molossus tropidorhynchus*.



PLATE XXXV

Daiquiri, Cuba

Fig. 1. Sea-wall showing typical limestone formation in which caves were found.

Fig. 2. Inner entrance to the Cueva de los Indios. The trees are growing in the area exposed by the fallen-in ceiling.



1



2

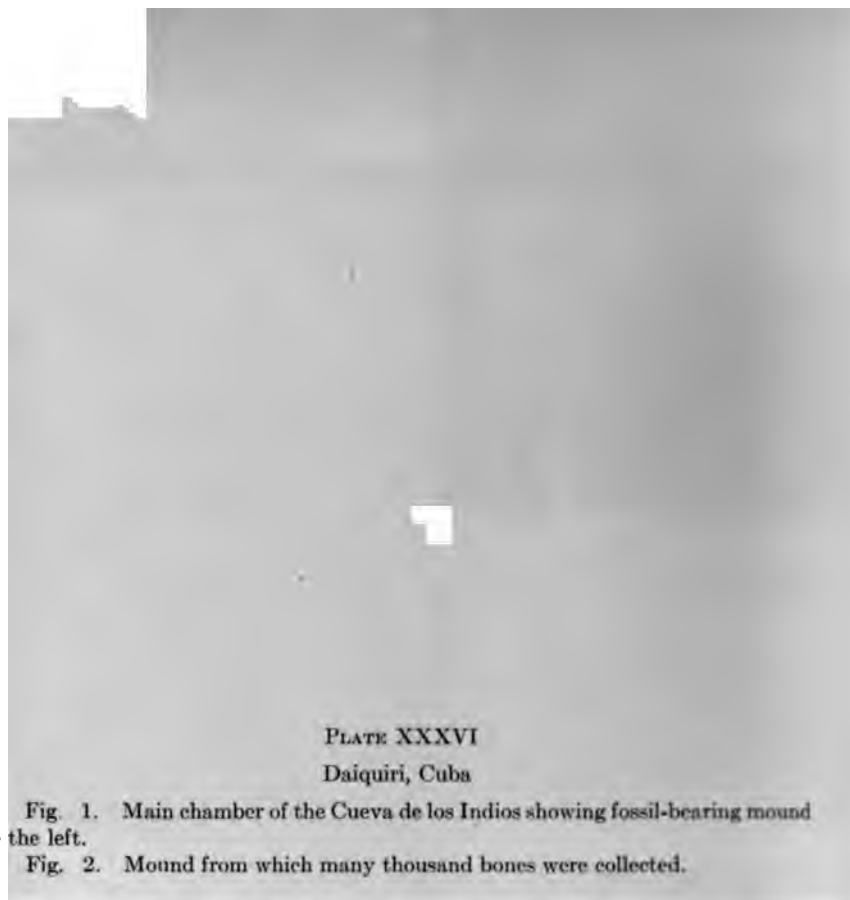


PLATE XXXVI

Daiquiri, Cuba

- Fig. 1. Main chamber of the Cueva de los Indios showing fossil-bearing mound to the left.
- Fig. 2. Mound from which many thousand bones were collected.



1



2

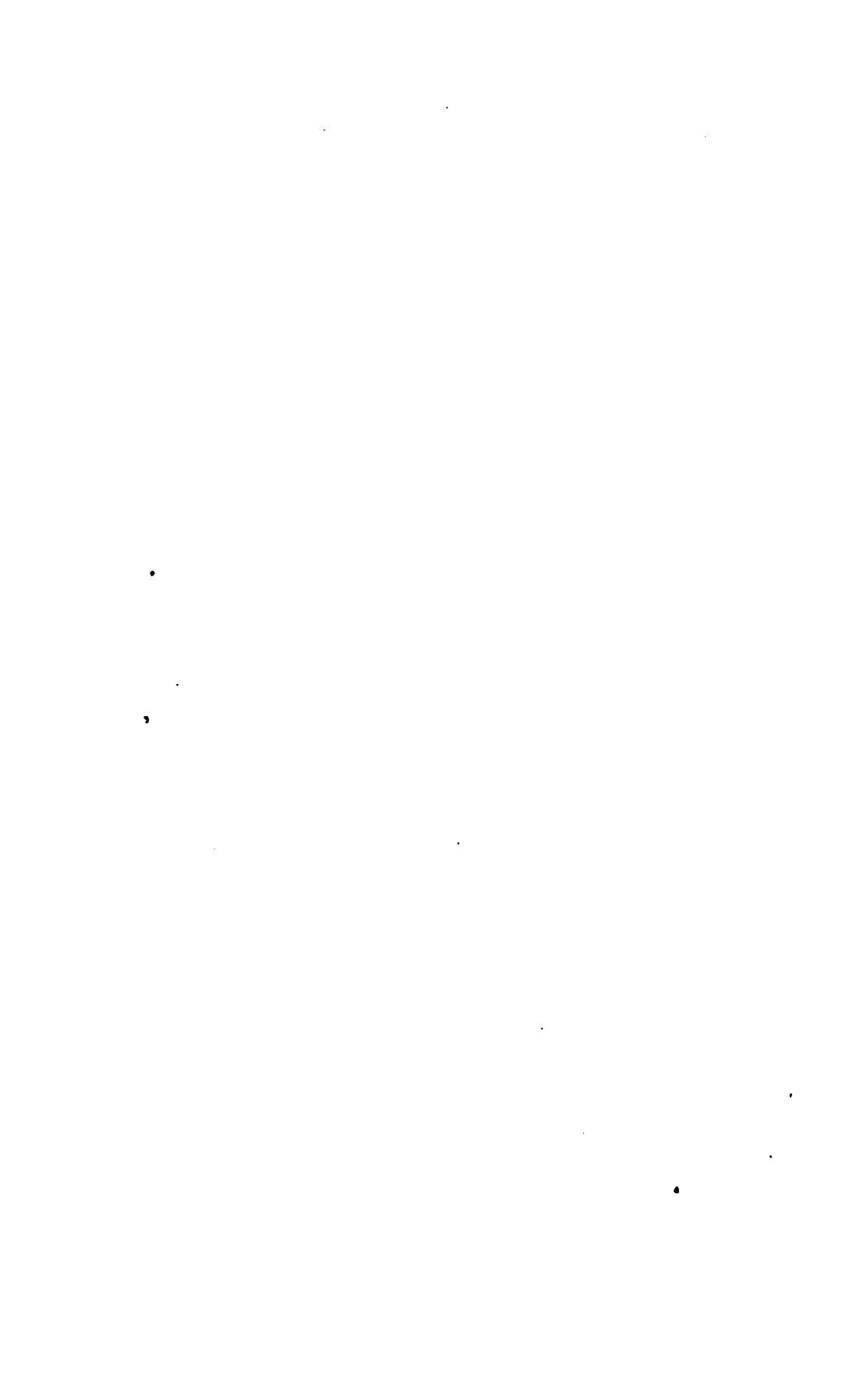
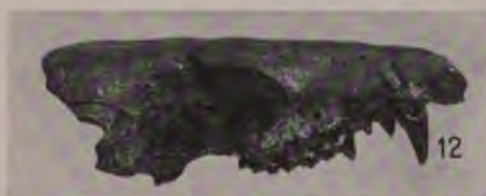


PLATE XXXVII

Skulls of West Indian Mammals. All figures natural size except Figs. 11-13, which are about twice natural size.

- Fig. 1. *Artibeus jamaicensis*, No. 41010, Daiquiri, Cuba.
- Fig. 2. *Artibeus jamaicensis*, No. 41011, Daiquiri, Cuba.
- Fig. 3. *Artibeus jamaicensis parvipes*, No. 41012, Daiquiri, Cuba.
- Fig. 4. *Artibeus jamaicensis parvipes*, No. 41013, Daiquiri, Cuba.
- Fig. 5. *Artibeus jamaicensis parvipes*, No. 41113, Daiquiri, Cuba.
- Fig. 6. *Nesophontes edithae*, No. 17114, ♂, Porto Rico.
- Fig. 7. *Nesophontes edithae*, No. 17107, ♀, Porto Rico.
- Fig. 8. *Nesophontes micrus*, No. 17627, ♀ Daiquiri, Cuba.
- Fig. 9. *Nesophontes micrus*, No. 17631, ♂, Daiquiri, Cuba.
- Fig. 10. *Nesophontes longirostris*, No. 17626, sex. indet., Daiquiri, Cuba.
- Fig. 11. *Nesophontes micrus*, No. 17631, ♂, Daiquiri, Cuba.
- Fig. 12. *Nesophontes micrus*, No. 17633, ♂?, Daiquiri, Cuba.
- Fig. 13. *Nesophontes longirostris*, No. 17626, sex indet., Daiquiri, Cuba.



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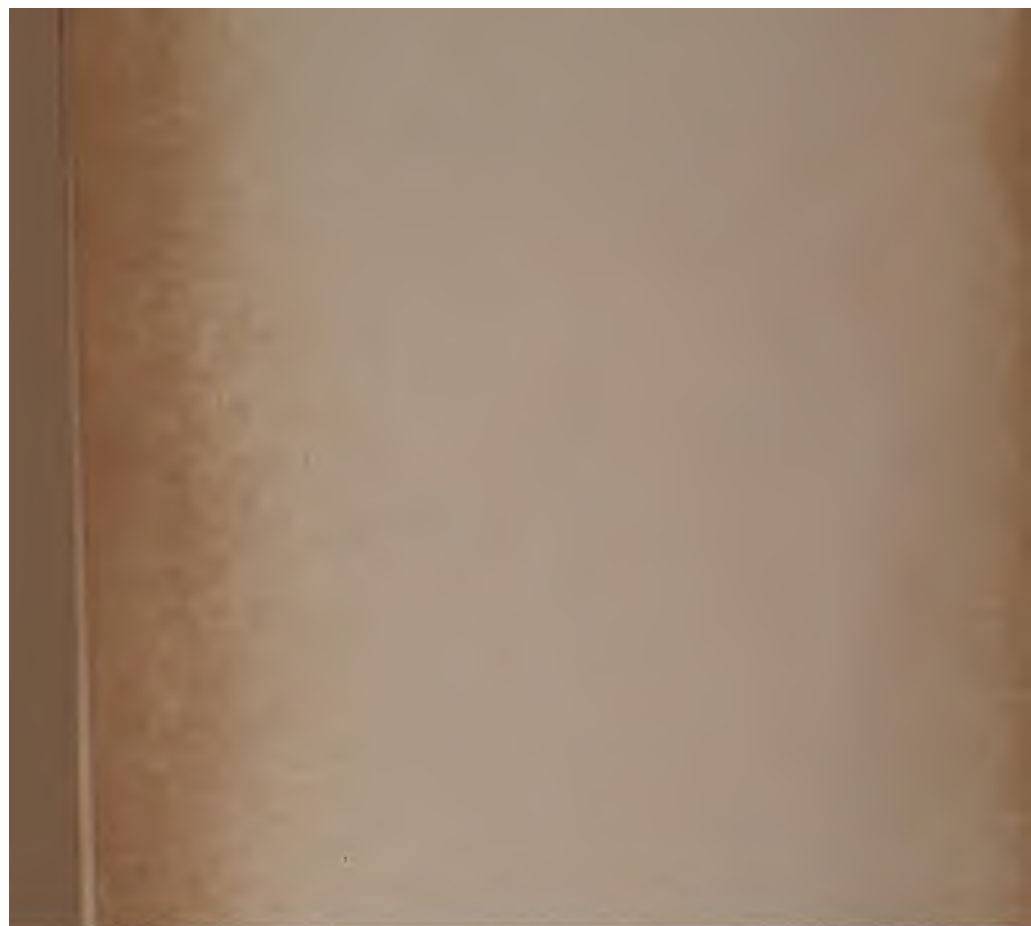
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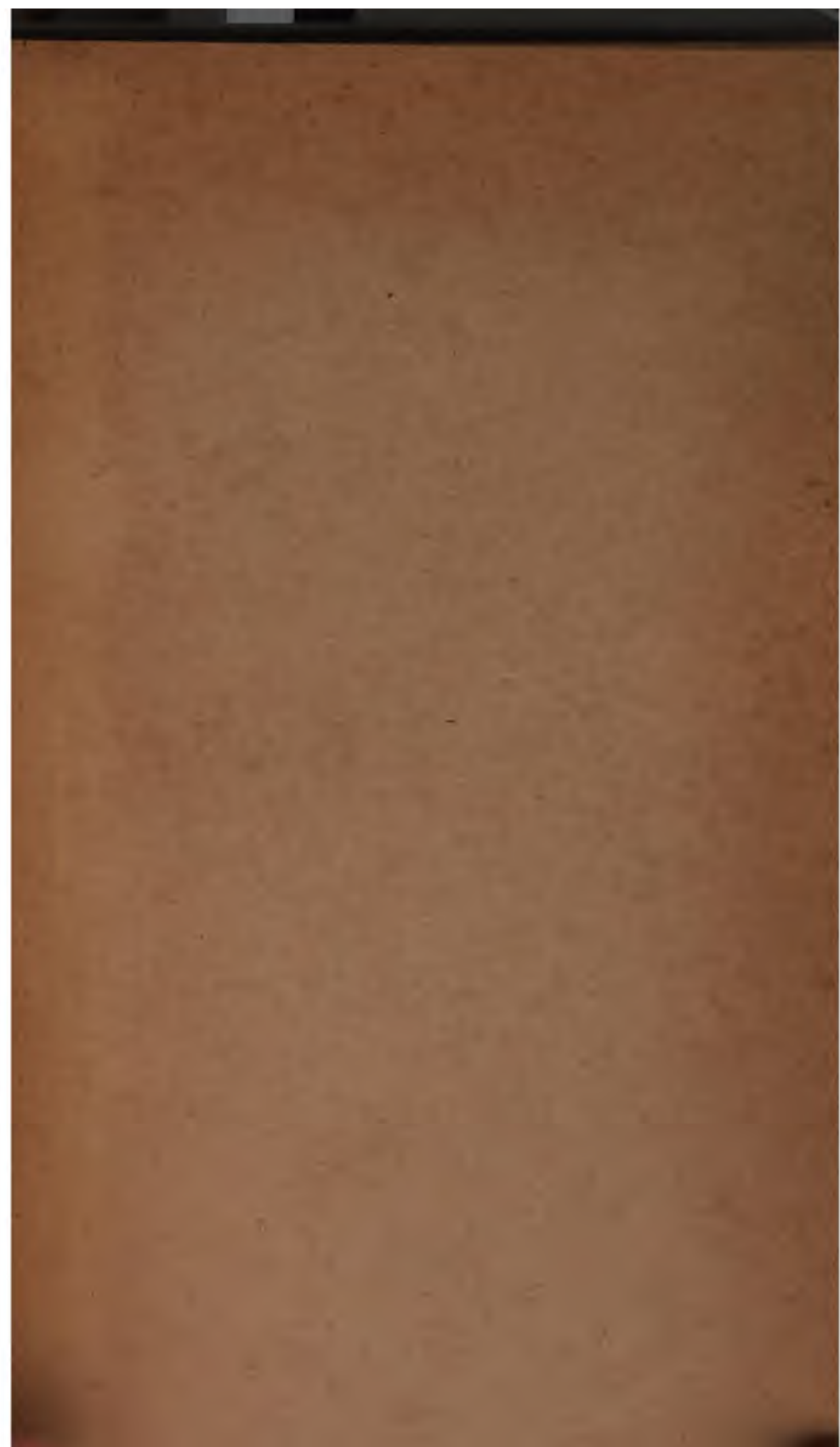
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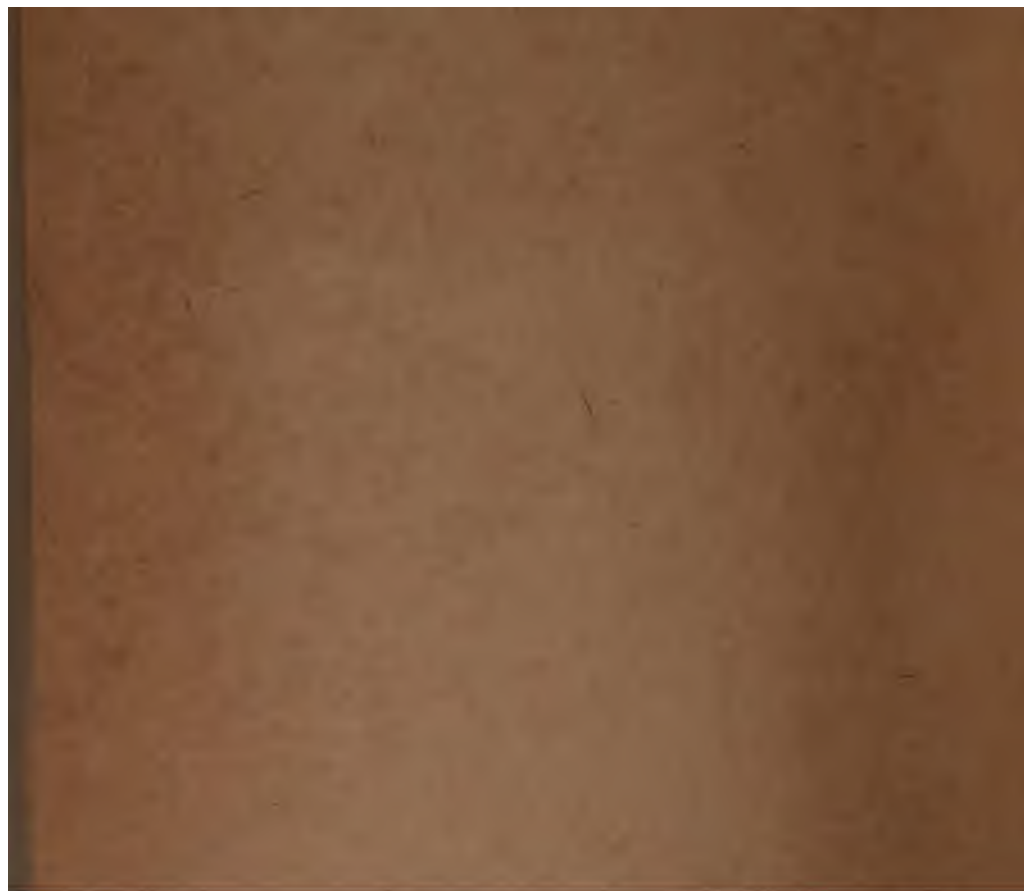
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